

# TM 9-722

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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## TANK-MOUNTING BULLDOZER M2

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BY RM/JS ON 110204

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DEPARTMENT OF THE ARMY • DECEMBER 1950

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# CHAPTER 1

## INTRODUCTION

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### Section I. GENERAL

#### 1. Scope

*a.* This manual contains instructions for operation and organizational maintenance of the tank-mounting bulldozer M2 for the using organization, and instructions for field and depot maintenance for ordnance maintenance personnel.

*b.* The appendix contains a list of current references, including supply catalogs, technical manuals, and other available publications applicable to the tank-mounting bulldozer M2.

#### 2. Maintenance Allocation

*a.* ORGANIZATIONAL MAINTENANCE ALLOCATION. In general, the prescribed organizational maintenance responsibilities will apply as reflected in the allocation of tools and maintenance parts in the appropriate column of the current ORD 7-8 SNL G-247, and in accordance with the extent of disassembly prescribed in this manual for the purpose of cleaning, lubricating, or replacing authorized spare parts. In all cases where the nature of the repair, modification, or adjustment is beyond the scope or facilities of the using organization, the supporting ordnance unit should be so informed so that trained personnel with suitable tools and equipment may be provided or other proper instructions issued.

*b.* FIELD AND DEPOT MAINTENANCE ALLOCATION. The publication herein of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depots and arsenals. In general, the prescribed maintenance responsibilities will apply as reflected in the allocation of maintenance parts listed in the field and depot maintenance columns of the current ORD 7-8 SNL G-247.

Instructions for depot maintenance are to be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Provisions of parts listed in the depot stock column of ORD 7-8 SNLG-247 will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization.

### **3. Forms, Records, and Reports**

*a. GENERAL.* Forms, records, and reports are designed to serve necessary and useful purposes. Responsibility for the proper execution of these forms rests upon commanding officers of all units operating and maintaining bulldozers. It is emphasized, however, that forms, records, and reports are merely aids. They are not a substitute for thorough practical work, physical inspection, and active supervision.

*b. AUTHORIZED FORMS.* The forms, records, and reports generally applicable to units operating and maintaining these bulldozers are listed below. No forms other than approved Department of the Army forms will be used in operating and maintaining the bulldozer. Pending availability of all forms listed, old forms may be used. For a current and complete listing of all forms, see current SR 310-20-6. For instructions on use of these forms, refer to FM 9-10.

Department of the Army Lubrication Order, LO 9-722.

Standard Form 91, Operator's Report of Motor Vehicle Accident.

Standard Form 91A, Transcript of Operator's Report of Vehicle Accident.

Standard Form 93, Report of Investigating Officer.

Standard Form 94, Statement of Witness.

WD Form 30, Report of Claims Officer.

DD Form 110, Vehicle and Equipment Operational Record.

WD AGO Form 9-71, Locator and Inventory Control Card.

WD AGO Form 9-72, Ordnance Stock Record Card.

WD AGO Form 9-73, Data for Registration—Motor Vehicle.

DA AGO Form 9-74, Motor Vehicle Operator's Permit.

DA AGO Form 9-75, Daily Dispatching Record of Motor Vehicle.

WD AGO Form 9-76, Request for Work Order.

WD AGO Form 9-77, Job Order Register.

WD AGO Form 9-78, Job Order.

DA AGO Form 9-79, Parts Requisition.

WD AGO Form 9-80, Job Order File.

WD AGO Form 9-81, Exchange Part or Unit Identification Tag.

DA AGO Form 348, Driver's Qualification Record.

WD AGO Form 460, Preventive Maintenance Roster.

DA AGO Form 461-5, Limited Technical Inspection.  
DA AGO Form 468, Unsatisfactory Equipment Report.  
DA AGO Form 478, Modification Work Order and Major Unit  
Assembly Replacement Record and Organization Equipment  
File.  
WD AGO Form 614, Accident-Identification Card.  
WD AGO Form 811, Work Request and Job Order.  
WD AGO Form 811-1, Work Request and Hand Receipt.  
WD AGO Form 865, Work Order.  
WD AGO Form 866, Consolidation of Parts.  
WD AGO Form 867, Status of Modification Work Order.

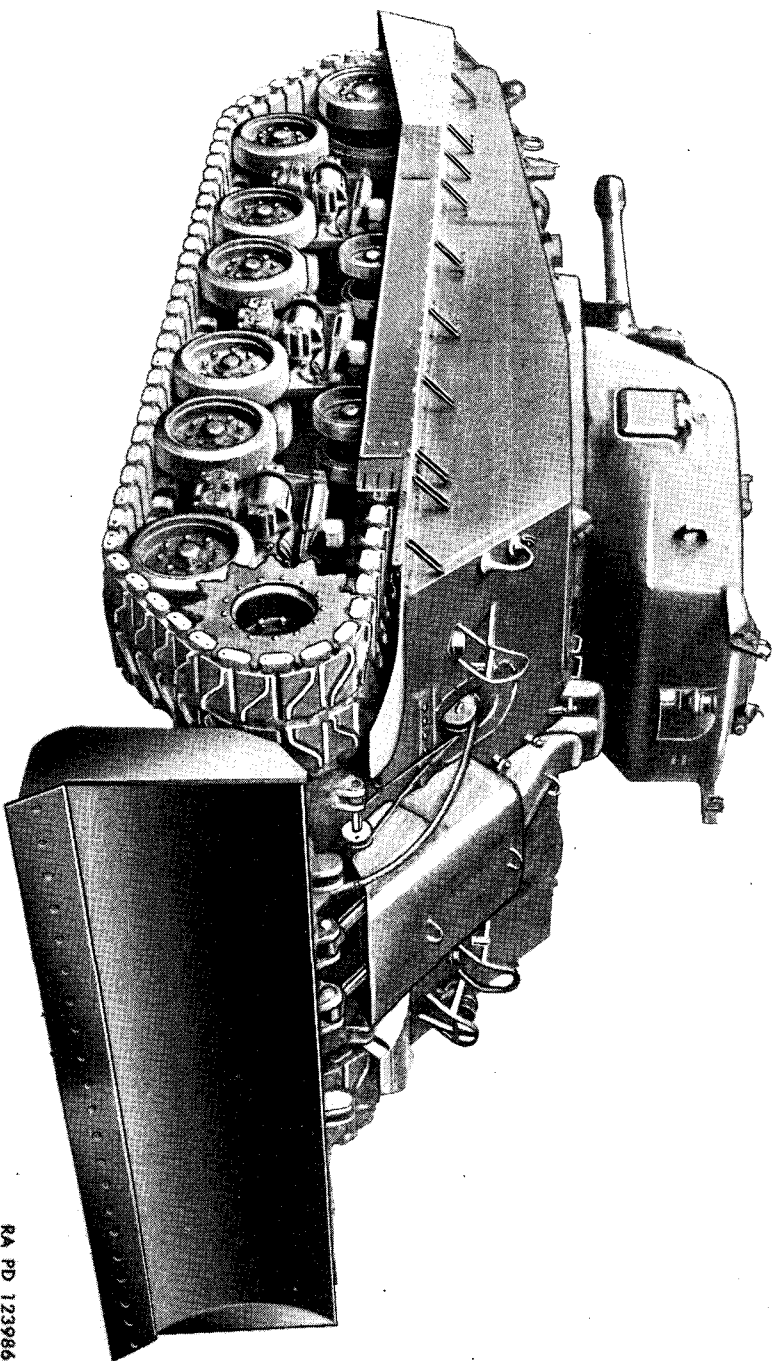
*c.* FIELD REPORT OF ACCIDENTS, INJURY OF PERSONNEL, OR DAMAGE TO MATÉRIEL. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in the SR 385-10-40 series. These reports are required whenever accidents involving injury to personnel or damage to matériel occur.

*d.* REPORT OF UNSATISFACTORY EQUIPMENT OR MATERIALS. Any suggestions for improvements in design, maintenance, safety, and efficiency of operation prompted by chronic failure or malfunction of the matériel, spare parts, or equipment or as to defects in the application or effect of prescribed petroleum fuels, lubricants, and/or preserving materials will be reported through technical channels to the Chief of Ordnance, Washington 25, D. C., ATTENTION: ORDFM, using DA AGO Form 468 (Unsatisfactory Equipment Report). Such suggestions are encouraged in order that other organizations may benefit.

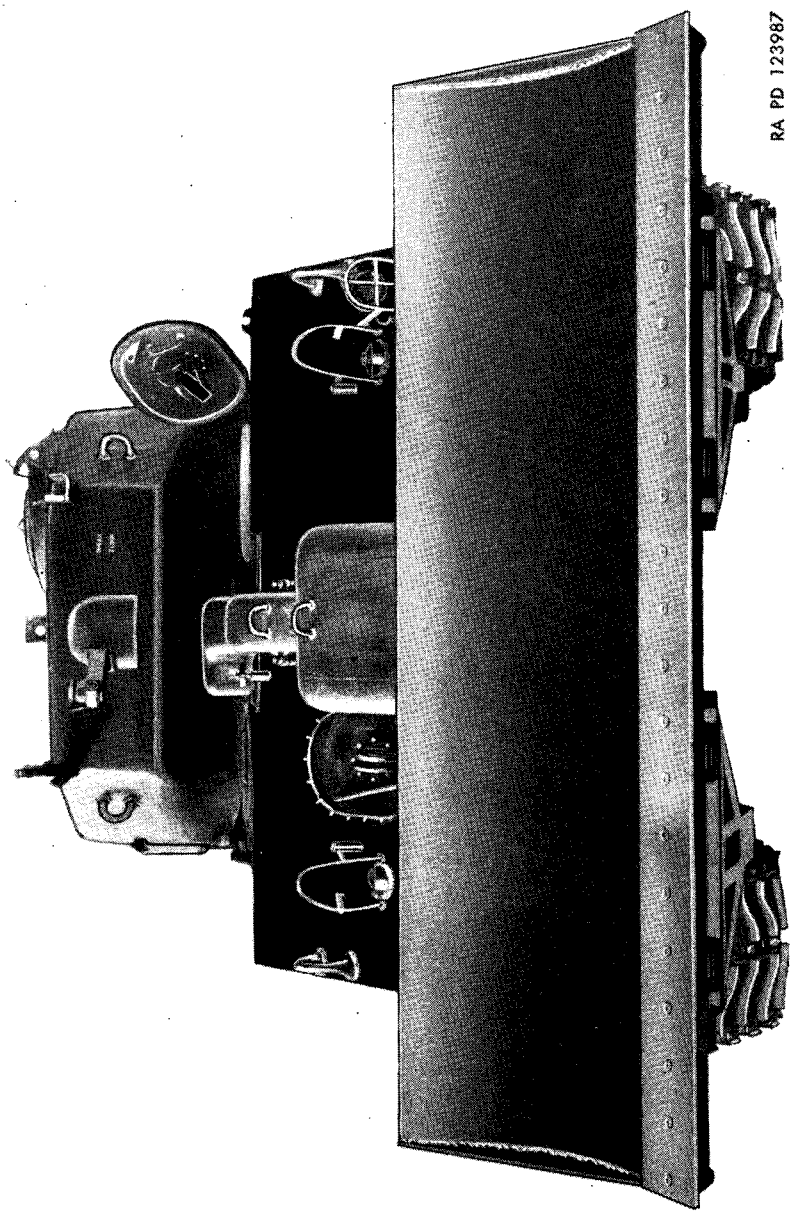
## **Section II. DESCRIPTION AND DATA**

### **4. Description**

*a.* The M2 bulldozer (figs. 1 and 2) is mounted on medium tank M4A3, 76-mm gun, and consists primarily of a large blade so mounted that it is capable of moving earth when propelled by the vehicle. This blade—called the moldboard assembly—is supported by two push beams, pivot mounted to brackets that are welded to the under side of the differential-carrier housing, at each side of the front of the vehicle. The push beams, together with two tilt arms (also pivoted to brackets which are welded to the differential-carrier housing), two connecting links, and the moldboard, all form a quadrilateral linkage which is operated (raised or lowered) by dual, double-acting cylinders.



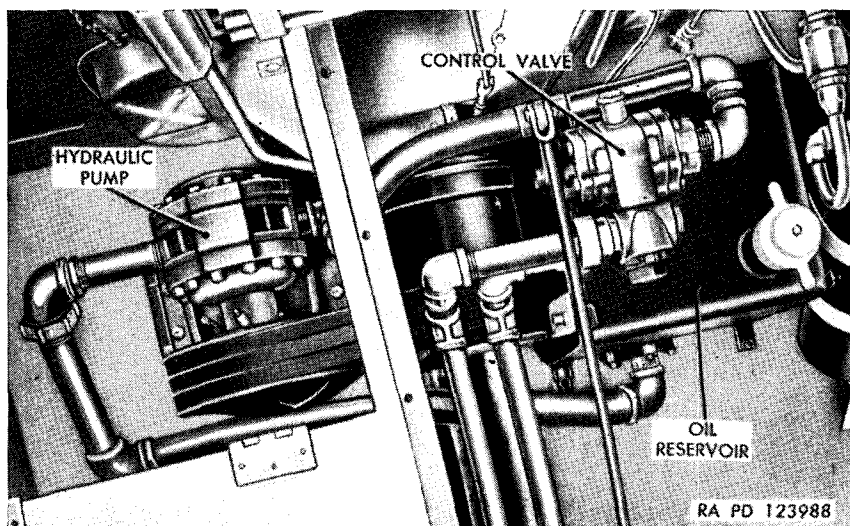
*Figure 1. Right front view of bulldozer M2 mounted on medium tank M4A3.*



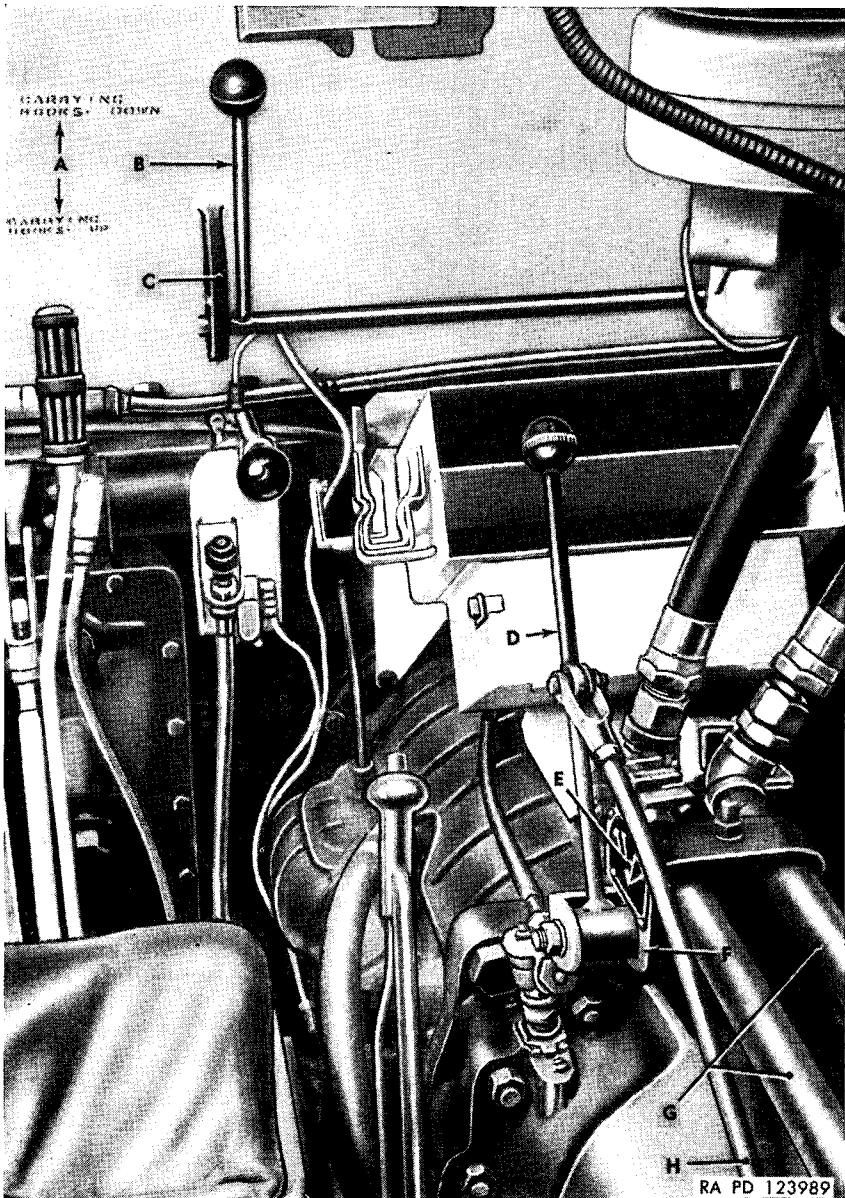
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*Figure 2. Front view of bulldozer M2 mounted on medium tank M4A3.*

b. A hydraulic pump, located in the interior of the vehicle at the rear of the turret compartment (fig. 3), and driven by the vehicle engine, provides hydraulic pressure for operation of the cylinders. The cylinders are controlled by a four-way control valve, also inside the vehicle, that is operated by a control-valve operating lever located adjacent to the driver's seat (fig. 4). Carrying hooks, manually operated from within the vehicle, are provided for travel use. There is an emergency-lift system (fig. 5), for lifting the moldboard into carrying position, which consists of a hand-operated emergency-lift pump and a single acting hydraulic emergency-lift jack. Both the emergency-lift pump and the emergency-lift jack are located in front of the assistant driver's seat.



*Figure 3. Hydraulic pump, control valve, and oil reservoir installed.*



- A—DECALCOMANIA
- B—HAND-CONTROL SHAFT
- C—HAND-CONTROL SHAFT BRACKET
- D—CONTROL-VALVE OPERATING LEVER
- E—CONTROL-VALVE OPERATING-LEVER INSTRUCTION PLATE
- F—CONTROL-VALVE OPERATING-LEVER BRACKET
- G—HYDRAULIC-CYLINDER INLET AND OUTLET REAR PIPES
- H—CONTROL ROD

Figure 4. Interior of vehicle showing location of hand control shaft and control-valve lever.



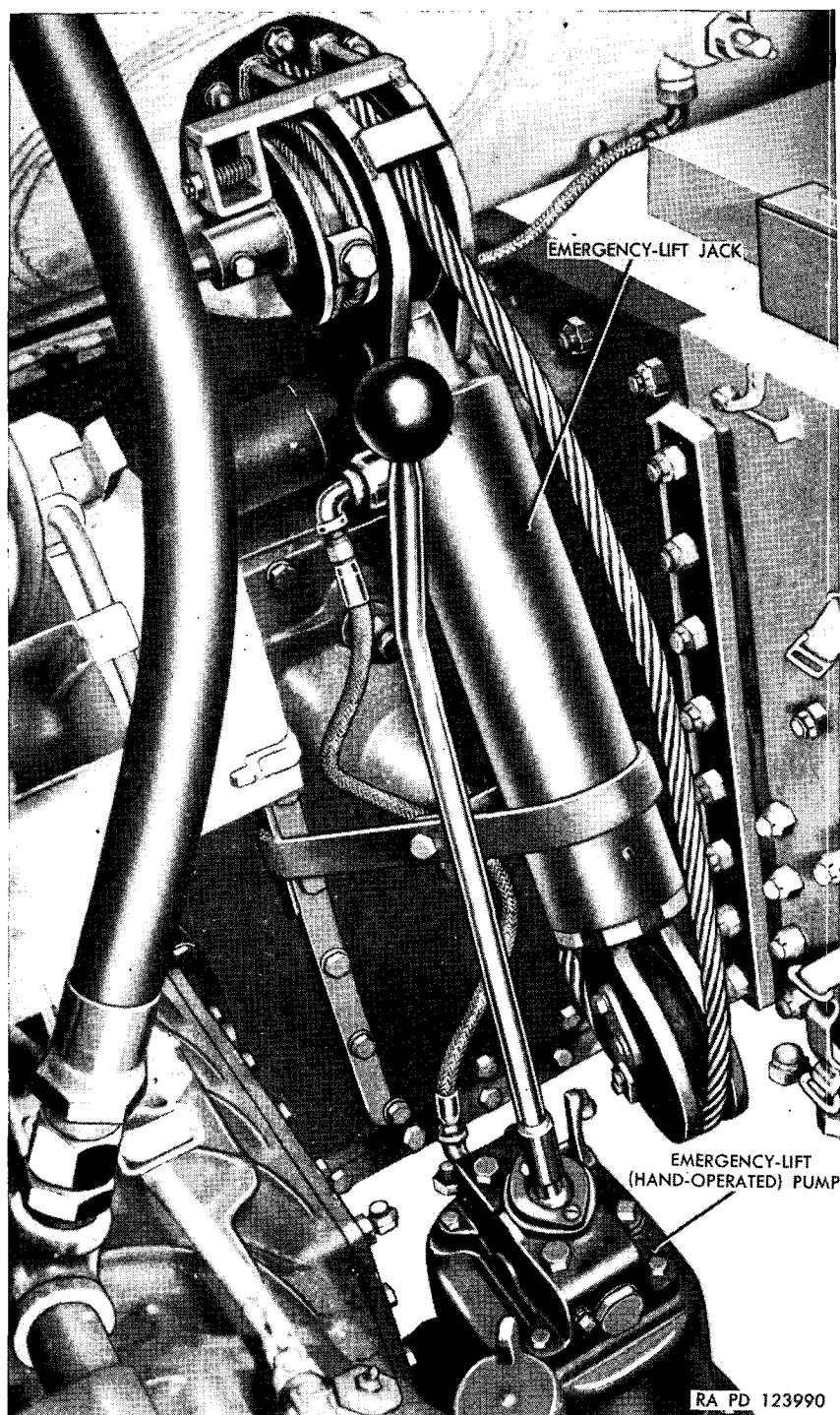


Figure 5. Emergency-lift jack and pump installed.

## 5. Data

### a. GENERAL.

Weight (net increase to vehicle including oil) ----- 6,000 lb.  
Moldboard length ----- 124 in.  
Moldboard height ----- 36¾ in.  
Reversible moldboard cutting edge ----- 124 x 8 x ¾ in.  
Angle of moldboard cutting edge (with horizontal) :  
    Normal position ----- 58 deg.  
    Lowest position ----- 65 deg.  
Relation of moldboard cutting edge to ground :  
    Carrying position ----- 29 in. above  
    Highest position ----- 30½ in. above  
    Lowest position ----- 12¾ in. below  
Vehicle angle of approach :  
    Carrying position ----- 24 deg.  
    Highest position ----- 25 deg.

### b. PERFORMANCE.

Rate of lift :  
    Vehicle engine at 1,500 rpm ----- 5.83 in. per sec.  
    Vehicle engine at 2,100 rpm ----- 7.26 in. per sec.  
Forward speed of vehicle while bulldozing (vehicle engine at 1,500  
    rpm and low gear) ----- 1 to 3 mph.  
Recommended maximum speed of vehicle (with bulldozer attached) ----- 15 mph.

## CHAPTER 2

### INSTALLATION AND OPERATION INSTRUCTIONS

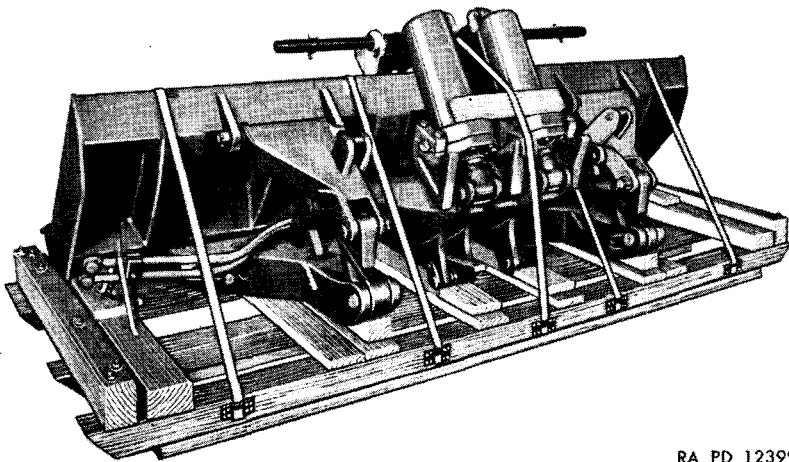
#### Section I. SERVICE UPON RECEIPT OF MATÉRIEL

##### 6. Scope

This chapter contains information for guidance of personnel responsible for the installation and operation of the equipment. Section I contains complete information for installation of the equipment on a vehicle and service upon receipt. Section II contains operating instructions and descriptions and locations of controls.

##### 7. Unpacking Crated Bulldozer and Identification of Parts

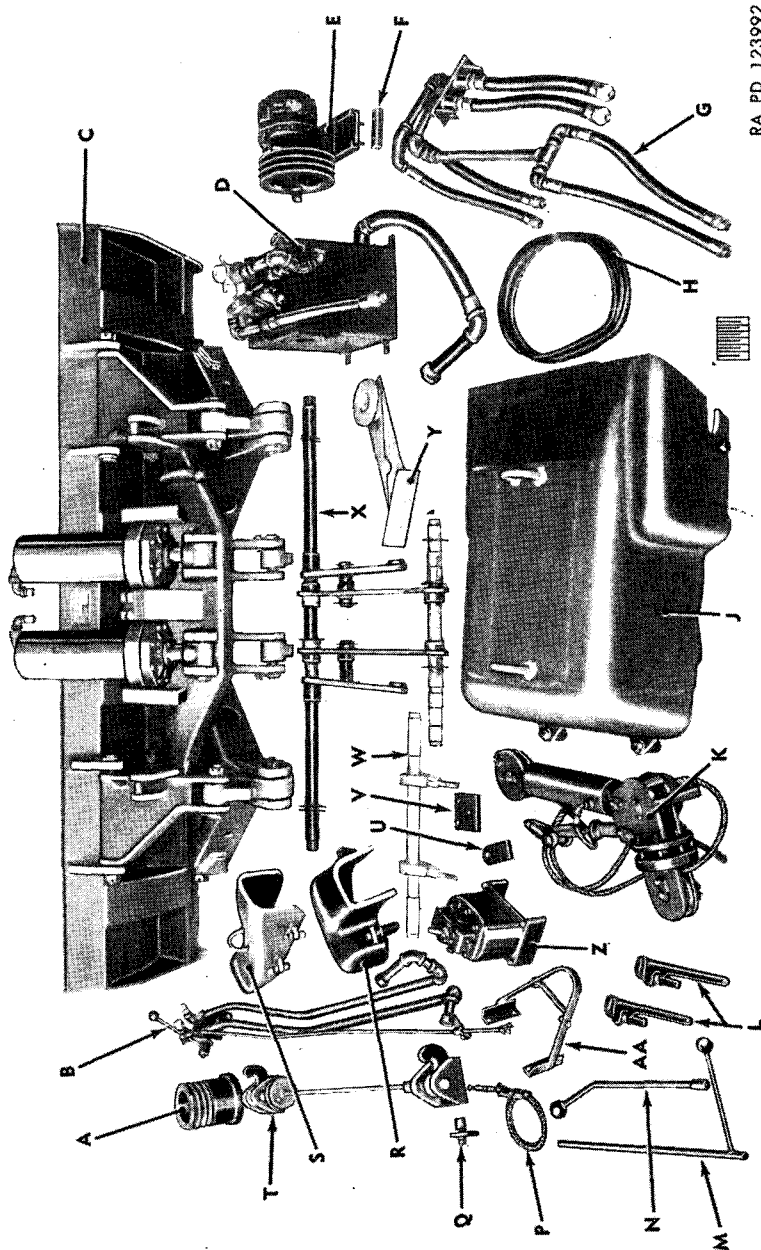
*a. UNPACKING THE BULLDOZER.* New bulldozers are shipped with the loose parts packed in suitable crates and with the moldboard assembly (having the push beams, tilt arms, push-beam links, and hydraulic-jack cylinders attached) secured by steel straps to a heavy wooden skid (fig. 6). The two (long) hydraulic-cylinder inlet and outlet rear pipes, assembled together, are strapped to the skid inside the angles formed by the tilt arms and push beams. When opening the crates, make certain that each is placed right side up, then remove the top by prying off the individual boards with a crowbar. Subsequent cutting of steel straps and wires which secure individual pieces inside the crates, and removal of wooden blocking pieces, will then permit all loose parts to be taken from the crates. To remove the moldboard assembly from the skid, it is only necessary to cut the steel straps used to secure it in place. As this assembly is exceedingly heavy, a crane must be used for removing it from the wooden skid.



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*Figure 6. Moldboard as shipped.*

b. IDENTIFICATION OF PARTS. The bulldozer is shipped with many of the parts already assembled, and some of these assemblies will have to be partially disassembled prior to installation of the bulldozer on the tank. Before disassembling any of the parts as shipped, identify each assembled group or loose part by reference to figure 7 to make certain that no parts are missing. Table I provides a list of loose parts and/or assembly groups as shipped.



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Figure 7. Identification of bulldozer parts (refer to table I).

Table I. Bulldozer components as shipped.

Key letter (fig. 7)	Item	Quantity
A	Hydraulic-pump drive pulley-----	1
B	A group consisting of: Two hydraulic-cylinder inlet and outlet rear pipes with clamps and connecting unions, elbows, nipples—together with the operating lever shaft supporting bracket and the control-valve operating lever.	1
C	A group consisting of: Moldboard with cutting edge, push beams, tilt arms, push-beam links, lift link, and hydraulic cylinders.	1
D	Hydraulic-pump reservoir and lines and fittings-----	1
E	A group consisting of: Hydraulic-oil pump, hydraulic-pump driven pulley, hydraulic-pump support, hydraulic-pump mounting base, and two hydraulic-pump mounting base clamp plates.	1
F	Hydraulic-pump mounting base spacer block-----	2
G	A group consisting of: Hydraulic-cylinder inlet and outlet pipe adapter, reducing Y fitting, hydraulic-cylinder inlet front pipe, pipe tee, six rubber hoses—together with connecting elbows and nipples.	1
H	Hydraulic-pump belt set (three belts)-----	1
J	Hydraulic-piping lower guard with mounting blocks, bolts, and washers.	1
K	A group consisting of: Emergency-lift jack, sheave inner support, sheave outer support—together with emergency-lift cable, three emergency-lift cable sheaves, cable (anchor-end) connector, cable clevis, and connecting pins, bolts, and washers.	1
L	Adjustable pipe wrench-----	2
M	Hand-control shaft lever-----	1
N	Hand-operated pump hand-control shaft-----	1
P	Carrying-hooks cable with carrying-hooks cable end and carrying-hooks cable turnbuckle.	1
Q	Clamp plate—together with mounting block, bolt, and washer.	1
R	Hydraulic-piping upper guard with mounting blocks, bolts, and washers.	1
S	Hydraulic-piping center guard with mounting blocks, bolts, and washers.	1
T	Carrying-hooks shaft assembly-----	1
U	Hand-control shaft bracket-----	1
V	Fire extinguisher mounting base-----	1
W	A group consisting of: The 31½-inch eye alining bar, and the two alining eyes.	1
X	A group consisting of: The 65¾-inch alining bar, 2 L-shaped alining fixtures, 2 tilt-arm alining plates, the 30¾-inch cylinder bracket alining bar, 4 cylinder bracket alining bushings, 12 spring retainers, and two 7-inch alining bars.	1

Table I. Bulldozer components as shipped—Continued

Key letter (fig. 7)	Item	Quantity
Y	A group consisting of: Template fixture with adapter, washer, and cap screw.	1
Z	A group consisting of: Emergency-lift hand-operated pump and two mounting plates.	1
AA	Emergency-lift jack supporting bracket-----	1

Note. This table is not to be used for requisitioning replacements.

## 8. Installation of Bulldozer on Vehicle

### a. GENERAL INFORMATION.

- (1) The M2 bulldozer can be mounted on any M4A3 medium tank designed or modified to take a 76-mm gun. Brackets, which are to be welded to the differential-carrier housing of the vehicle, have been fabricated to tolerances which will permit their assembly on the maximum sized housing likely to be encountered (variations inherent in the manufacture of a casting of the size of this housing make it impossible to fabricate an attaching assembly—such as the M2 bulldozer—which will be a perfect fit). Whenever a vehicle is encountered in which the housing has been made to smaller tolerances than the maximum, it will be necessary to shim under those brackets which the alining fixtures hold away from contact with the housing. This shimming must be accomplished before welding the brackets to the housing. The vehicle selected should be properly serviced and in good operating condition.
- (2) The bulldozer components are shipped with all rubber hoses, pipes, and fittings assembled into various assemblies (fig. 7). These must be completely disassembled prior to installation and be assembled again in proper sequence during installation, using mica-base antiseize compound where necessary, to assure leakproof connections. Use mica-base antiseize compound on all pipe and hose connections, except pipe and hose unions. Use the compound sparingly to prevent any of it from entering inside the parts. The proper sealing compound to be used on all threaded fittings is mica-base antiseize compound.

Note. Inasmuch as each assembly of pipes, hoses, and fittings is correctly arranged for installation of the equipment, it is recommended that each assembly be disassembled just prior to its use, instead of

all the assemblies being disassembled at the same time at the beginning of the installation. It will then be easy to assemble the parts of each assembly in proper order.

**b. ARRANGEMENT OF INSTRUCTIONS.** The installation procedure given herein is divided into four divisions. The first two divisions of work can be performed simultaneously. Upon completion of the first division of work and paragraph 14*b* of the second division, the work in the third division can be started. The fourth division of work cannot be started until all three preceding divisions of work have been completed. The divisions of work are as follows:

- (1) Welding of brackets to the exterior of the vehicle hull (pars. 10 through 12).
- (2) Installation of all components in the interior of the vehicle (pars. 13 through 19).
- (3) Installation of the remaining exterior components (pars. 20 through 28).
- (4) Installation of the emergency-lift components and carrying-hooks controls (pars. 29 through 34).

*Note.* All locational references (right and left) to parts and assemblies—whether being installed externally or internally—are made with respect to the position of the driver of the vehicle.

## **9. Tools Required**

All operations required for installation of the bulldozer can be accomplished with tools normally issued to automotive mechanics and with such standard items as a hydraulic jack, a hoist with a 2-ton or more capacity, a cutting torch, an electric-arc welder, and a ½-inch capacity electric drill. All special alining fixtures and drill templates are furnished with each bulldozer kit. Two 12-inch adjustable pipe wrenches are also furnished.

## **10. Removal of Interfering Parts From Exterior of Vehicle**

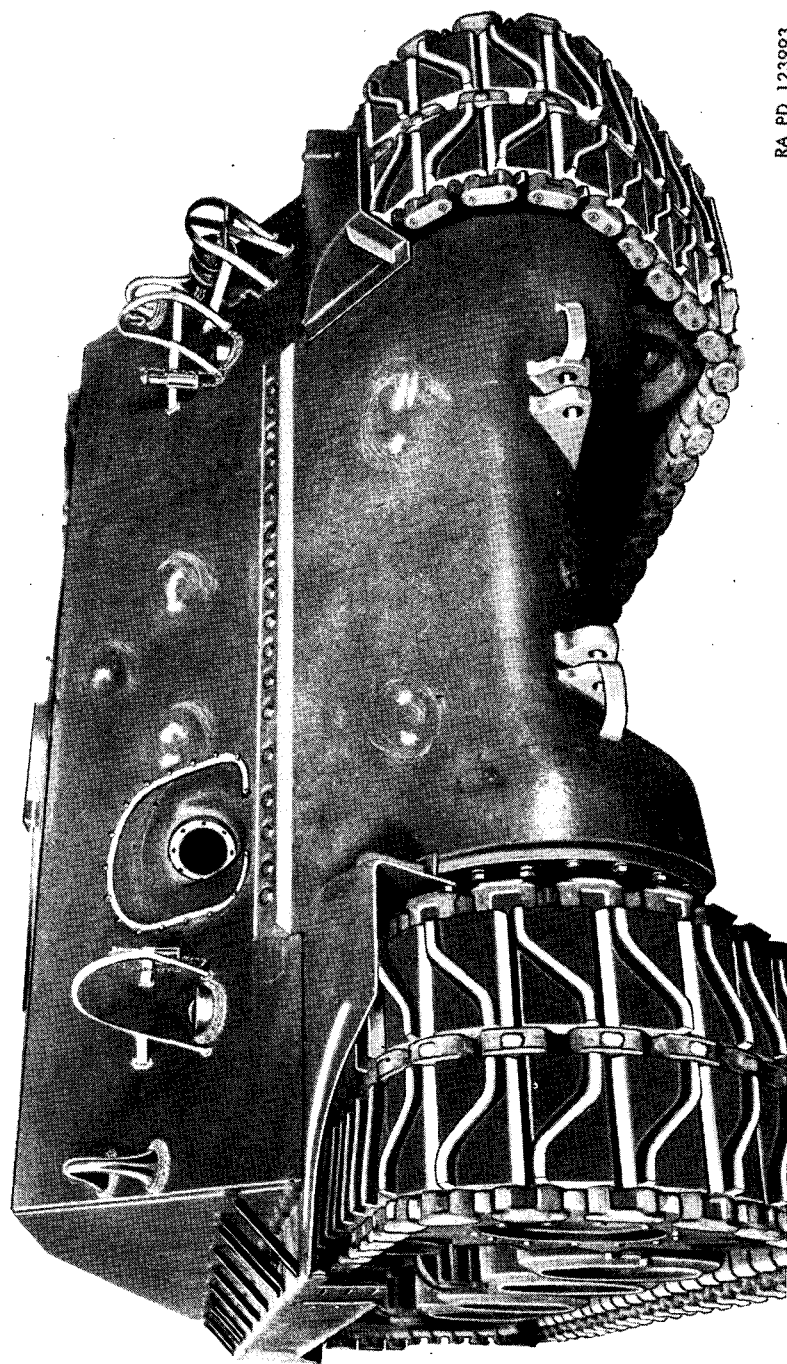
*a.* Cut the 76-mm gun-traveling-lock hinge block and latch and the tow-cable clamp from the front of the hull (fig. 8) and grind the hull surface smooth at these three points. Retain the traveling-lock parts and cable clamp for later installation.

*b.* Cut away the two front tie downs from the front of the hull.

*c.* Remove the two front tow hooks and pins from the front of the hull.

*d.* Remove the front sections of both fenders and also the splash guards which hold the inner side of each front fender section to the hull. Retain these pieces for a later installation.

*e.* Remove all parts bolted into the cal. .30 machine gun port, both outside and inside the hull. This port is located in front of the assistant driver's seat.



RA PD 123993

*Figure 8. Exterior of medium tank M4A3 ready for installation of bulldozer M2.*



## 11. Installation of Hydraulic Cylinder, Tilt-Arm, and Lift-Link Brackets

a. Remove the fifth bolt from each end (counting each end bolt as number one) of the row of bolts which attach the top of the differential-carrier housing to the center section of the hull. Install the two alining eyes (furnished with the alining fixture) in the places occupied by these bolts, attaching these with the same nuts which were removed from the bolts. Make certain that all dirt and all paint are removed from the outer surface of the vehicle around each bolt hole, before installing the eyes, so that the shoulder of the eyes can be drawn tightly and squarely against the hull surface.

b. Uncouple both vehicle tracks at front and roll these tracks back to place the end out of the way (TM 9-759).

c. Remove the three foremost cap screws from each final drive cover. These are the second, third, and fourth screws forward from the leading edge of each fender. Attach the two tilt-arm alining plates to the respective final drive covers, using the cap screws just removed. The tilt-arm alining plates can be identified for right and left positions by the fact that each is correctly positioned when the straighter of the two sloping edges is at top and the bosses around the bolt holes are facing inward against the drive cover (these bosses fit into the recessed areas in the drive cover around the bolt holes). Do not tighten the cap screws at this time.

d. Remove the spring retainers from each end of the long (65 $\frac{3}{4}$ -inch) alining bar, and slide the two tilt-arm pivots onto the respective ends of this bar. (These two pivots are interchangeable with respect to right or left positions.) Slide each pivot far enough onto the bar so that the bar can be installed in the two tilt-arm alining plates by first inserting one end into one plate, and then sliding it far enough through the plate to install the other end into the remaining plate. As these parts were not removed, the bar already has the two L-shaped alining fixtures installed at its center, and when it is positioned at the front of the vehicle by installing it in the two tilt-arm alining plates, the longer ends of these L-shaped alining fixtures (which hold the 30 $\frac{3}{4}$ -inch alining bar) must be uppermost. After installing the bar, securely tighten all of the screws which hold the two tilt-arm alining plates to the respective final drive covers.

e. Position the two tilt-arm brackets on the long bar so that each is pressed outward against the inner face of the adjacent tilt-arm alining plate. Secure each bracket in its position by installing a spring retainer in the bar groove which is adjacent to the inner side of the bracket.

f. From the moldboard assembly (C, fig. 7), remove the push-beam

links. These are the links which connect the lift link to the respective push beams. Each is attached at each end by a threaded pin secured with a castle nut and cotter pin.

*g.* From the moldboard assembly (C, fig. 7), remove the two hydraulic cylinders and the three hydraulic-cylinder brackets. Each hydraulic-cylinder piston-ram end is secured to the lift link by a pin secured to the lift link by a bolt and lock washer. The three brackets are located at the tops of the cylinders by stub shafts welded to the cylinders and are wired to the cylinders to hold them in place for shipment.

*h.* Install the two push-beam links over the respective ends of the 30 $\frac{3}{4}$ -inch alining bar. The link ends which have built-up bosses around the pin holes are the ends which fit over this bar, and each link is installed with the boss facing inward. Install a spring retainer in each of the grooves at the outer ends of the bar, and slide the push-beam links outward against these retainers.

*i.* Place a cylinder bracket alining bushing on each end of the 30 $\frac{3}{4}$ -inch alining bar, sliding these bushings inward against the spring retainers which position the push-beam links. Place one hydraulic-cylinder outer bracket (the outer brackets are the two smaller ones) on each end of the 30 $\frac{3}{4}$ -inch alining bar, over the bushing just placed on the bar. It may be necessary to loosen the caps on these brackets (by loosening the four attaching bolts) to make this installation; but the caps should again be securely tightened. Push the brackets inward against the spring retainers at the ends of the bars. Each bracket is installed with the cap uppermost.

*j.* Insert the 31 $\frac{1}{2}$ -inch alining bar through one of the two alining eyes, then through the free (upper) ends of the two push-beam links, and then through the remaining alining eye.

*Note.* As it is the purpose of the push-beam links to hold the 30 $\frac{3}{4}$ -inch alining bar in true horizontal alinement with respect to the vehicle hull, it is essential that each link be kept pushed outward against the spring retainer at the ends of the 30 $\frac{3}{4}$ -inch alining bar so that the two links and the two short alining bars form a perfect rectangle which is correctly positioned by the two alining eyes.

*k.* Remove the cap from the hydraulic-cylinder center bracket (the large one) by taking out the four long bolts which secure it. Place this bracket under the 30 $\frac{3}{4}$ -inch alining bar, between the two upper ends of the L-shaped fixtures, and secure it in this position by replacing the cap and tightening. It is properly installed when the cap is uppermost and the bracket is exactly midway between the ends of the two L-shaped fixtures. The upper ends of these fixtures are positioned on the 30 $\frac{3}{4}$ -inch alining bar by spring retainers which

are placed in the two center grooves of the bar, and against which the outer faces of the L-shaped fixtures are pressed.

l. From the moldboard assembly (C, fig. 7), remove the two lift-link brackets. These are secured to the lift link by threaded pins with castle nuts and lock washers.

m. Place one of the lift-link brackets over each of the two 7-inch alining bars (which are installed at the lower ends of the L-shaped fixtures). Secure each bracket in place with a spring retainer. The grooves for these retainers are at the outer ends of the bar. Check to see whether or not the bores of the lift-link brackets are close enough in line with the bores of the tow-hook brackets (already on the vehicle) to permit later installation of the tow-hook pins. If not, install the tow hooks and pins at this time, repositioning the lift-link brackets as necessary.

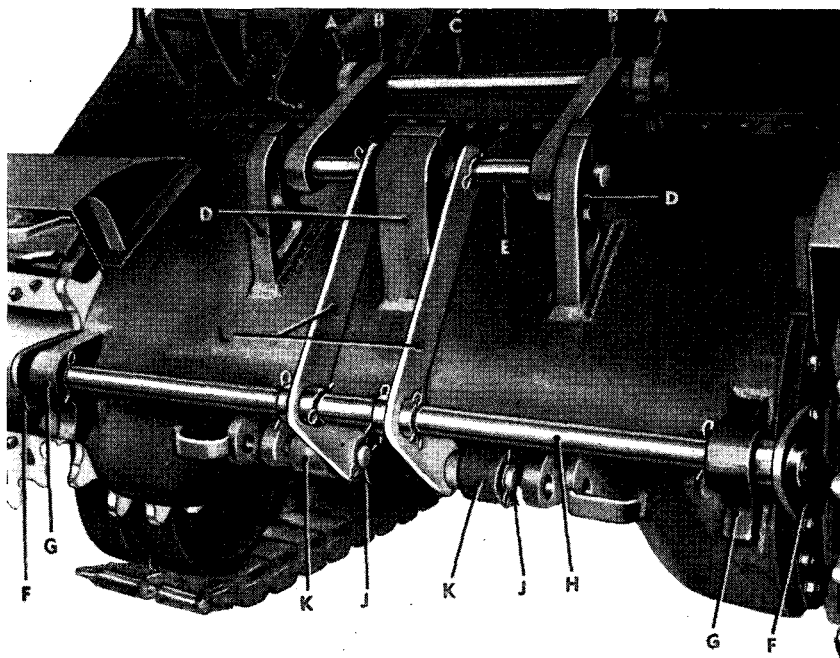
n. The two tilt-arm brackets, the three hydraulic-cylinder brackets, and the two lift-link brackets should now all be properly positioned against the vehicle hull. Check to make certain that they are, and also to make certain that all the spring retainers are in the proper grooves on the alining bars. There should be two spring retainers on the  $30\frac{3}{4}$ -inch alining bar (at the outer sides of the L-shaped fixtures), two on the long alining bar (at the inner sides of the tilt-arm brackets), four more on the long alining bar (one at each end). This is a total of 12 spring retainers. All must be properly seated in their grooves (fig. 9).

o. First shim (par. 8), then tack weld the brackets to the vehicle in the following sequence:

- (1) Tack weld the two tilt-arm brackets to the differential-carrier housing.
- (2) Tack weld the two lift-link brackets and the hydraulic-cylinder center bracket to the differential-carrier housing.
- (3) Hold the two hydraulic-cylinder outer brackets inward against the spring retainers at the ends of the  $30\frac{3}{4}$ -inch alining bar and tack weld these to the differential-carrier housing.

p. After all brackets have been securely tack welded, completely remove the alining fixtures and finish welding the brackets to the differential-carrier housing. Each bracket should be secured by a  $\frac{3}{4}$ -inch or larger weld, all the way around the base.

*Note.* When removing the alining fixtures, be sure to remove the two bushings inside the respective hydraulic-cylinder outside brackets. These last two bushings are used again in the installation of the push-beam brackets (par. 12).



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A—EYE BOLT  
B—PUSH-BEAM LINK  
C—31 1/2-INCH ALINING BAR  
D—HYDRAULIC-CYLINDER BRACKET  
E—30 3/4-INCH ALINING BAR  
F—ALINING PLATE

G—TILT-ARM BRACKET  
H—65 3/4-INCH ALINING BAR  
J—7-INCH ALINING BAR  
K—LIFT-LINK BRACKET  
L—L-SHAPED FIXTURE

*Figure 9. Hydraulic-cylinder, tilt-arm-, and lift-link-brackets alining fixtures installed.*

## 12. Installation of Push-Beam Brackets

a. Insert the two 7-inch alining bars through the respective lift-link brackets and install one of the push-beam links over the inner end of each bar. The link ends which do not have built-up bosses around the pin bores are the ends which fit over these bars. Place a spring retainer at each end of each bar (in the grooves provided) to retain the bars in proper position in the lift-link brackets, and to hold the push-beam links onto the bars.

b. Insert the long alining bar through the free ends of the two push-beam links, and center this bar with respect to these links. Near the center of this bar there are two sets of grooves, each set containing three grooves. The center groove of each set should—when the bar is properly centered—be against the outer side of the adjacent push-beam link so that the bar can be retained in exact center position by

two spring retainers placed at the outer sides of the links. Install the two spring retainers in these grooves.

c. From the moldboard assembly (C, fig. 7), remove the two push-beam brackets. Each bracket is attached to the free end of its push beam by a pin that is secured to the push beam by a bolt and lock washer.

d. There are two grooves at each outer end of the long bar. Install a spring retainer in the second groove in from each end. Install the two push-beam brackets on the respective ends of the long bar, and push them up against these spring retainers. Each bracket is correctly positioned when the cutaway section, at one side of the bracket base, is facing inward.

e. With a man at each end of the long alining bar and a third man stationed at the middle, swing the bar back and up until the two brackets are raised up flush against the under side of the differential-carrier housing. Hold the bar in this position by using a jack under the center of the bar (fig. 10) to keep the brackets pressed against the vehicle. Check to make certain that each bracket is pushed inward against the adjacent spring retainer, and that the cutaway sections of the two brackets are positioned against the hull so as to allow easy removal of the vehicle final drive drain plugs.

*Note.* There is a certain amount of "play" in the alining fixture as set up. It is quite possible for the bar to swing back farther on one side than the other, thus allowing the brackets to be slightly "cocked." Check for alinement by sighting the positions of the bar ends with respect to the adjoining edges of the respective vehicle tracks. Make certain that the bar is in horizontal alinement across the front of the vehicle. In raising the bar up with the jack, be very careful not to bend it.

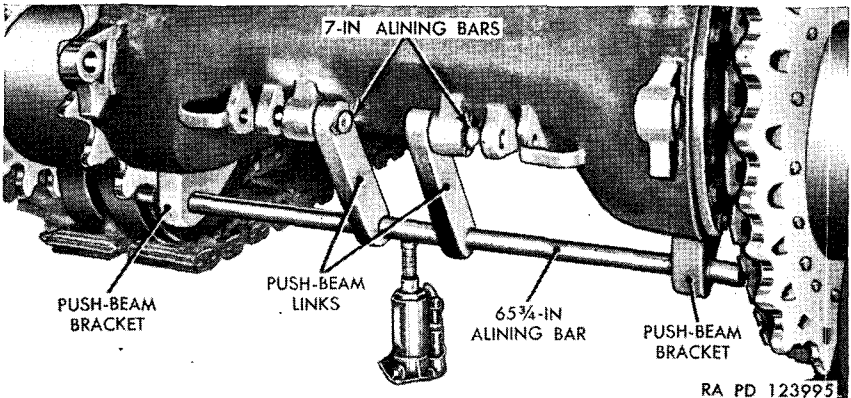
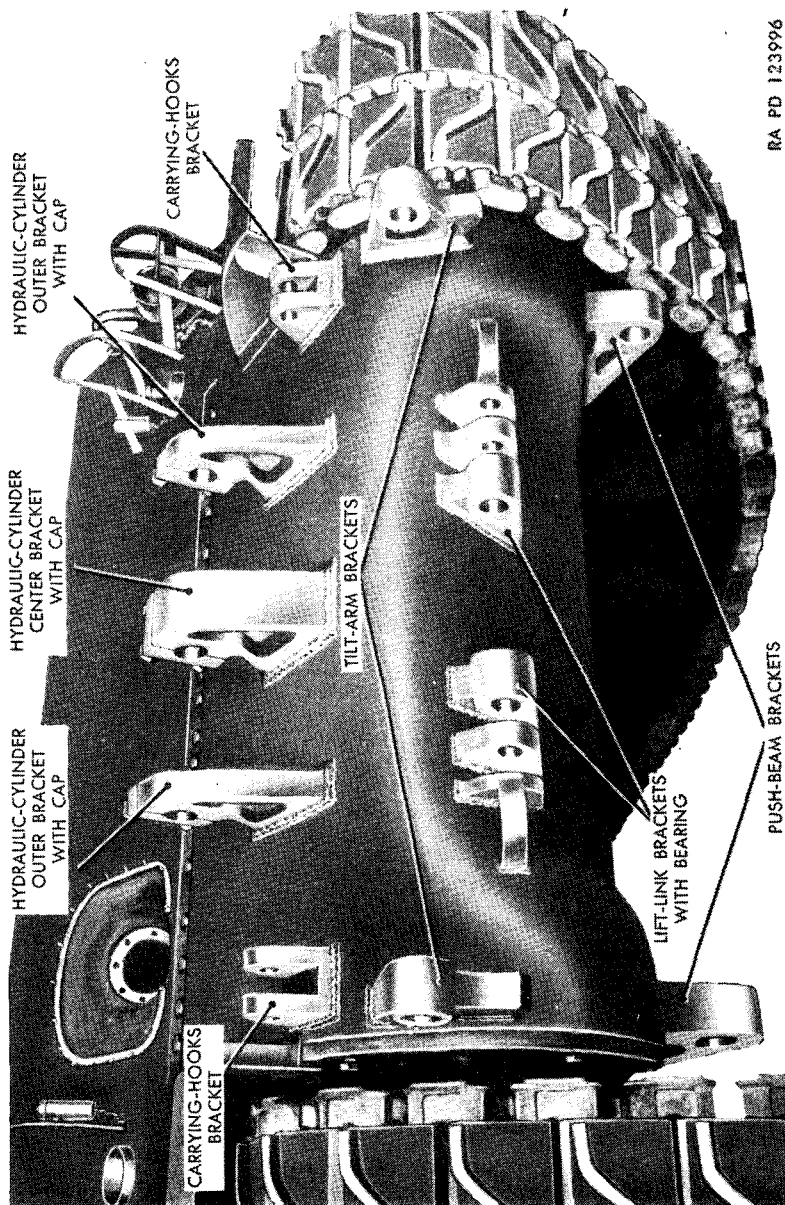


Figure 10. Push-beam link and push-beam brackets alining fixture installed.

f. If necessary, shim under the brackets (par. 8) then securely tack weld each bracket in place.

g. Remove the alining fixture, and complete welding of the brackets to the differential-carrier housing with a  $\frac{3}{4}$ -inch or larger weld all around the base of each bracket.

*Note.* Make certain, however, that the weld does not protrude too far on the inner side of each bracket at the cutaway section to interfere with removal of the final drive drain plugs. It will be easier to do the welding if the front end of the vehicle is raised several feet in the air and is placed on blocks; otherwise, there is insufficient room under the vehicle to do a proper job.



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*Figure 11. Hydraulic-cylinder, carrying-hook, tilt-arm, lift-link, and push-beam brackets.*

### 13. Removal of Parts From Interior of Vehicle

a. Remove all floor plates from the left side of the interior above the stowage boxes.

b. Remove both the right and left stowage boxes located at the rear of the turret compartment. It will be necessary to cut the boxes into pieces small enough to be passed out through the turret opening.

c. Remove the support angle that is connected to the hull-floor center angle at the right rear corner of the ammunition box.

d. Remove the universal joint cover.

e. Disconnect all cables from the collector ring, then remove the collector ring by taking out the four bolts which hold it.

f. Remove the left floor support angle that extends through the center of the interior.

g. Remove all the sloping ammunition-stowage racks from the left side of the interior.

h. Remove the right periscope mount and cover, then cut the cover hinges from the hull. Grind off the remaining material to leave a smooth surface on the hull.

*Note.* The interior of the vehicle is now stripped down, ready for installation of the bulldozer components (fig. 12). All the parts removed—excepting the stowage boxes and right periscope mount and cover—are to be installed later and must be retained. Removal of parts, as indicated, and installation of bulldozer components can be performed without removing the gun and turret from the vehicle; but removal of the gun and turret makes it easier to do the internal work. Do not attempt to remove gun and turret from the vehicle unless proper equipment for installation is available.

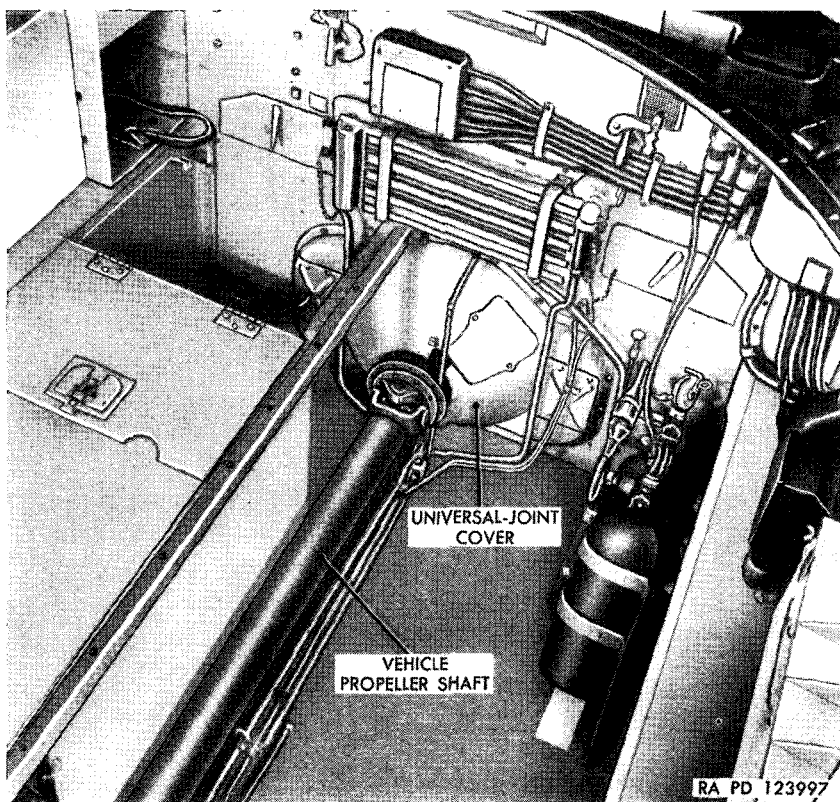


Figure 12. Interior of medium tank M4A3 ready for installation of bulldozer M2.

#### 14. Installation of the Hydraulic-Cylinder Inlet and Outlet Pipe Adapter

a. Install the two rubber hoses (fig. 13) into the bottom of the hydraulic-cylinder inlet and outlet pipe adapter. Tighten the hose fittings securely.

b. Insert the free ends of the two hoses down through the right periscope opening (fig. 13), and push the adapter into place in this opening. Place enough flat washers between the sides of the adapter (most of which is now inside the vehicle) and the inner sides of the periscope opening flanges to take up any space that exists between each flange and the adjacent adapter side, then install a bolt through the opening at each side of the adapter, through the spacer washers, and through the bolt hole in the flange. Secure each bolt with a lock washer and nut.

*Note.* Completion of this step makes it possible to start work on the third division of work, when the first division of work has also been completed.



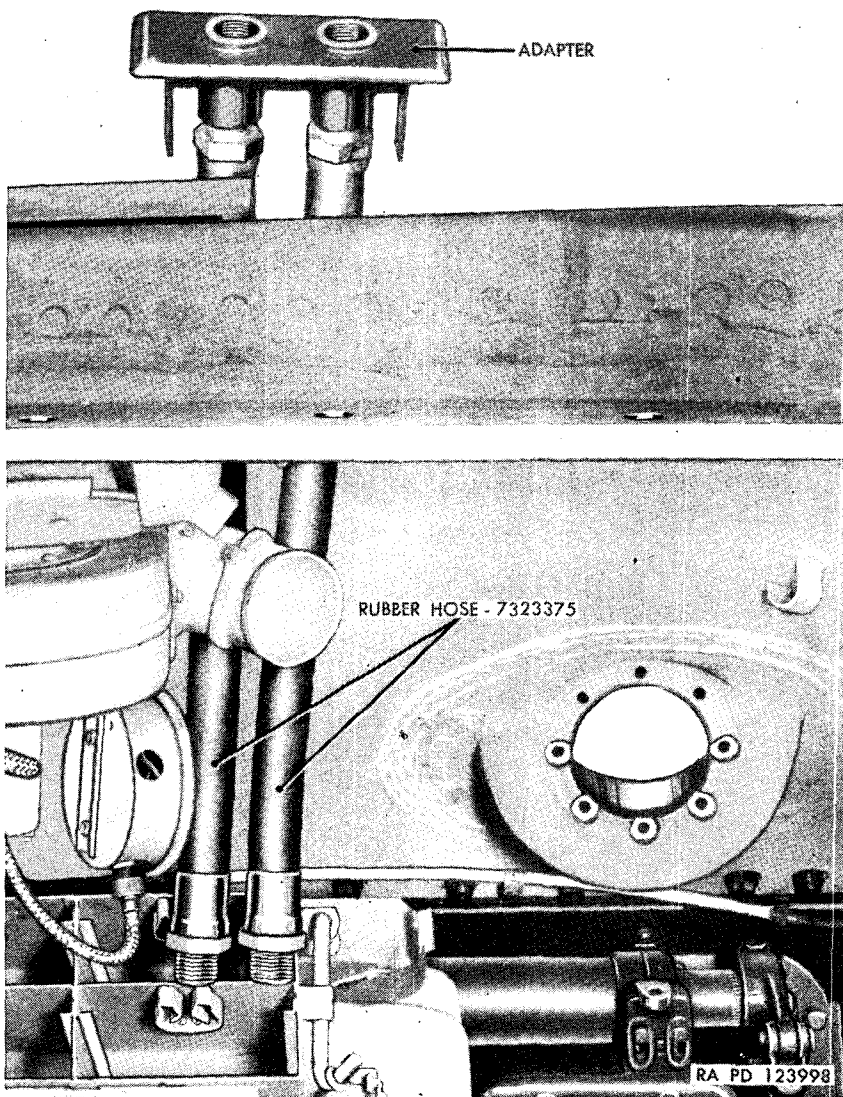


Figure 13. Hydraulic-cylinder inlet and outlet pipe adapter partially installed.

## 15. Installation of Hydraulic-Pump Mounting Base

a. Remove the vehicle propeller shaft.

*Note.* On some vehicles it will be possible to install the hydraulic-pump drive pulley without completely removing the propeller shaft from the vehicle. In this case, the shaft can be slipped forward into the front universal joint slip joint, after disconnecting the rear propeller shaft universal joint, and there will be room at the back to install the pulley (par. 16).

b. The template fixture is assembled prior to shipment. It is properly assembled when the adapter (large circular plate) is on the left side at top, with the largest diameter flange on the outer side, and is secured to the fixture by a large bolt with washer inserted from the opposite side of the fixture. Check the fixture for proper assembly. Loosen the bolt.

c. Place the assembled template fixture at the rear of the turret compartment (fig. 14). Install the spacer adapter over the clutch shaft, attaching it to the coupling flange with four  $\frac{3}{8}$  x  $1\frac{1}{2}$ -inch bolts.

d. Press the base of the template fixture securely against the vehicle floor plate and make certain that it is resting flat, then tighten the bolt to keep the fixture in this position.

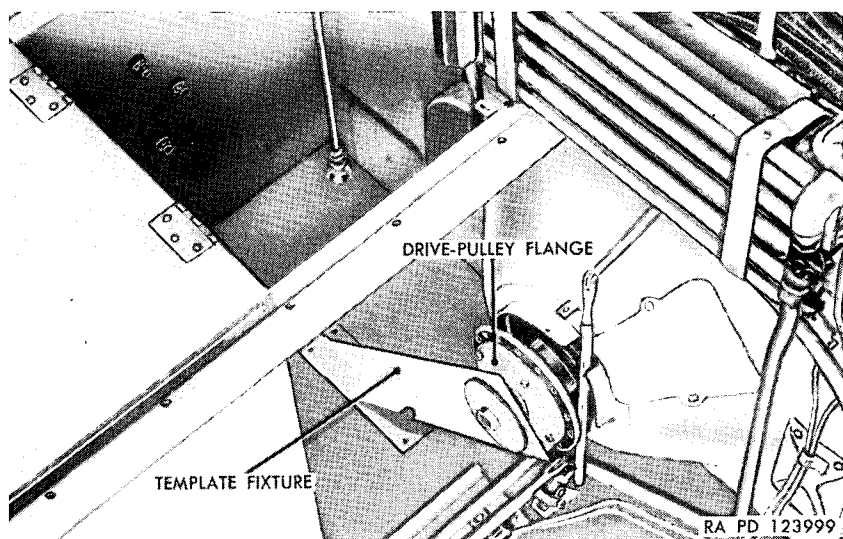


Figure 14. Hydraulic-pump base fixture installed.

e. Using the four centering holes in the four corners of the base of the template fixture, punch mark the floor plate for drilling at the center of these holes.

f. Remove the template fixture from the coupling flange by removing the four bolts which secure the spacer adapter to this flange.

g. Drill and tap the four punch-marked holes in the floor plate, using a  $\frac{1}{2}$ -20NF-2 tap. Install the hydraulic-pump mounting base at this location, placing the base on top of the two hydraulic-pump spacer blocks (one at each end of the base) and using four  $\frac{1}{2}$ -20NF-2 $\frac{1}{4}$ -inch screws.

*Note.* When installing the base, be sure to locate the end which holds the adjusting screw at the left side, so that the adjusting screw is nearest the center of the vehicle.

h. Place the two hydraulic-pump mounting plates in the slots provided in the mounting base (fig. 15).

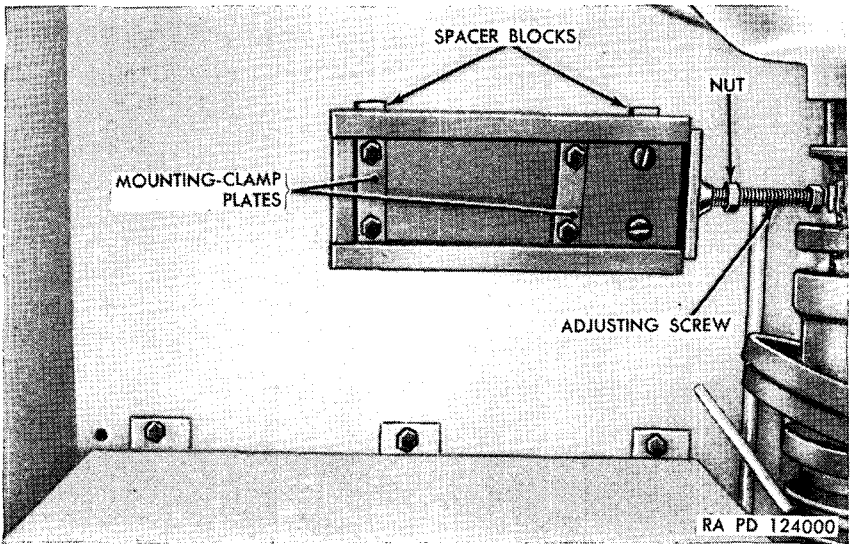


Figure 15. Hydraulic-pump base installed.

## 16. Installation of Hydraulic-Pump Drive Pulley

a. Slide the hydraulic-pump drive pulley over the rear end of the vehicle propeller shaft, with the grooved end of the pulley toward the front end of the shaft.

b. Hang the three belts of the hydraulic-pump belt set over the pulley.

c. Install the hydraulic-pump drive pulley flange on the clutch shaft coupling flange, using eight  $1\frac{5}{8}$ -inch shoulder bolts passed from back to front through the clutch shaft coupling flange, the drive pulley flange, and the universal joint flange. Secure each bolt with a castle nut, and tighten securely. Install a separate lock wire on each pair of nuts.

*Note.* In some vehicles, particularly those of early manufacture, the holes in the universal joint flange will be  $\frac{3}{8}$  inch in diameter and must be reamed to  $1\frac{1}{2}$ -inch diameter to permit use of the eight shoulder bolts.

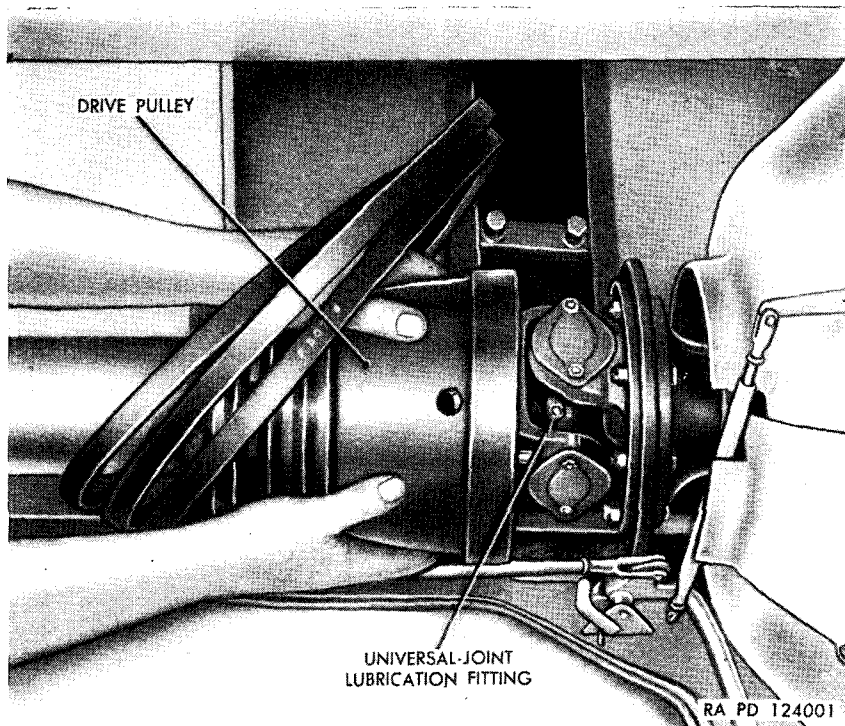
d. Install the propeller shaft in the vehicle (TM 9-759).

*Note.* To install propeller shaft, install the front end, hold the rear end raised above the clutch shaft coupling flange, place the drive flange against the clutch shaft coupling flange, then drop the rear end of the shaft into place.

e. Slide the hydraulic-pump drive pulley rearward on the propeller shaft and attach it to the hydraulic-pump drive pulley flange, using

eight bolts. Tighten bolts securely and install a separate lock wire on each pair of screws.

*Note.* When positioning the pulley against the flange, make certain that one or the other of the two holes in the pulley is directly over the lubrication fitting in the propeller shaft universal joint. If the locating dowel in the edge of the pulley will not permit one hole to be over the lubrication fitting, rotate the pulley to place the second hole over the fitting (fig. 16).

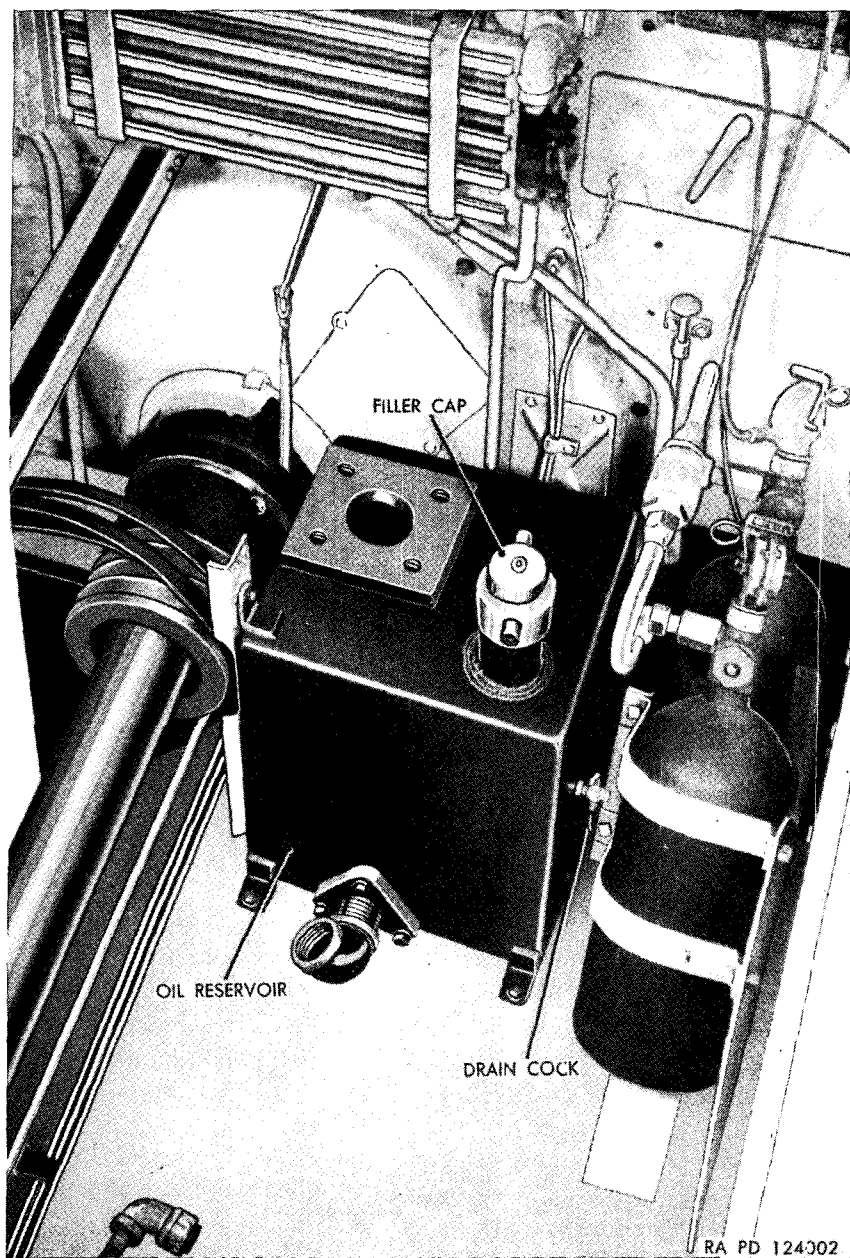


*Figure 16. Placing hydraulic-pump drive pulley over universal joint.*

## 17. Installation of Hydraulic-Pump Reservoir

*a.* Place the hydraulic-pump reservoir in position (fig. 17) at the rear of the turret compartment, between the fire extinguisher and the hydraulic-pump drive pulley (just installed).

*Note.* The reservoir should be pushed as far as possible back of the line established by the front wall of the area (on the right side of the vehicle) in which the hydraulic-pump mounting base has been installed. The farther back the reservoir can be located, the easier it will be to install the rubber hoses connecting the reservoir to the hydraulic pump (par. 19).



*Figure 17. Hydraulic-pump reservoir installed.*

b. Using a center punch, mark the vehicle floor plate for one hole at each of the lower rear corners of the reservoir.

*Note.* The mounting bolt holes in the two lower forward corners of the reservoir will ordinarily be alined with the drilled and tapped holes in the floor plate which were formerly used to attach the stowage box; but if the reservoir can be set farther back (as noted in the preceding step), it is better to do so, even though this means drilling and tapping of all four mounting holes.

c. Drill the punch-marked mounting holes in the floor plate and tap them with a  $\frac{3}{8}$ -20NF-2 tap.

d. Attach the lower front corners of the hydraulic reservoir to the floor plate, using the bolts and lock washers formerly used to attach the stowage boxes. Attach the lower rear corners of the reservoir to the floor plate with two bolts, with a lock washer and plain washer under each.

e. Take the support angle that was removed from the right rear corner of the ammunition box and cut out a section of the angle  $\frac{1}{2}$  inch deep by 4 inches long, located 6 inches below the top of the angle (fig. 18). (This cut-out is necessary to eliminate interference between the angle and the hydraulic-pump drive pulley, after the angle is installed to support the reservoir.)

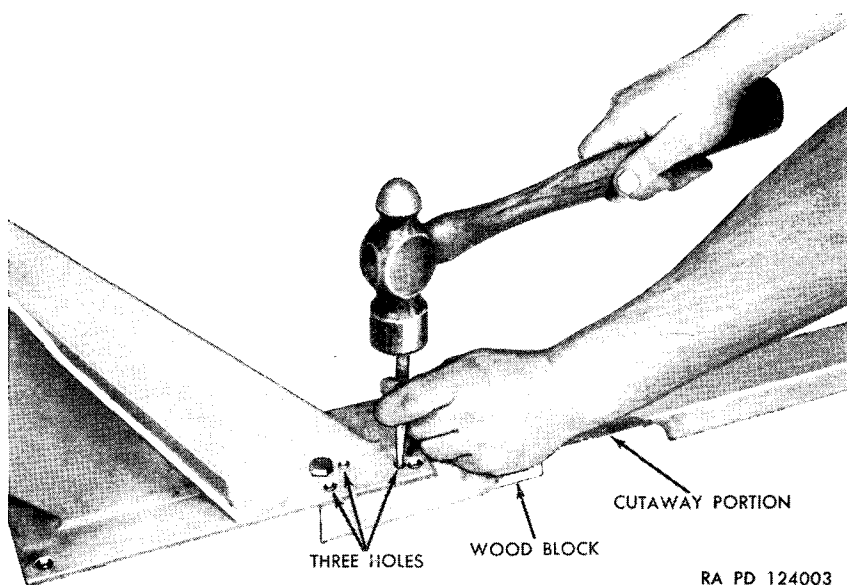


Figure 18. Marking vehicle support angle.

f. Lay the support angle on the floor, and place the base of the template fixture on top of the upper end of the angle (fig. 18). Secure the fixture to the angle with a bolt inserted through the large hole in the fixture base and through the uppermost hole in the angle. Aline

the sides of the fixture with the sides of the angle to make them flush, then securely tighten the nut on the bolt. Mark the centers of three holes to be drilled in the upper end of the angle, using the three centering holes of the template fixture which are nearest to the large hole through which the bolt has been inserted. None of the centering holes at the corners of the fixture—already used for marking the mounting holes for the hydraulic-pump mounting base—are used at this time.

*g.* Remove the template fixture from the support angle and drill three  $\frac{7}{16}$ -inch holes in the angle, as marked.

*h.* Install the support angle to the vehicle floor plate at its original position, but turned  $180^\circ$  so that the flat side is now toward the hydraulic reservoir. Use the same bolts formerly used to attach the angle to the floor plate.

*i.* Attach the upper right front corner of the hydraulic reservoir to the support angle, using one bolt with two flat washers, a lock washer, and a nut.

*j.* Check to make certain that the drain cock is properly installed in the tapped hole near the top on the left side of the reservoir (fig. 17).

*k.* Attach the hydraulic-pump control valve to the top of the reservoir (fig. 17), using four bolts with a lock washer under each.

*Note.* The valve is positioned with the control rod to valve stem head link facing the right side of the vehicle.

## **18. Installation of Hydraulic Pump With Support**

*a.* Install, in the order named, a  $1\frac{1}{4}$  x  $2\frac{1}{2}$ -inch nipple, a  $1\frac{1}{2}$ - to  $1\frac{1}{4}$ -inch reducing bushing, and a  $1\frac{1}{2}$ -inch  $90^\circ$  elbow union into the inlet (suction) side of the hydraulic pump. The inlet side is that side which will be on the right side of the vehicle, when the pump is installed with the pulley facing forward. Tighten the fittings securely and set the union so that the elbow points downward, toward the front (toward pulley) at an angle of approximately  $45^\circ$ .

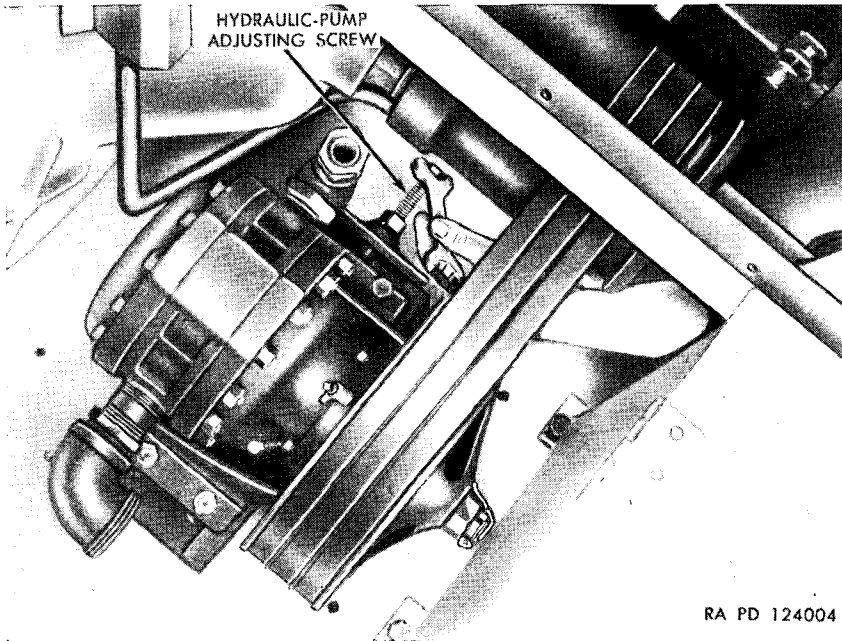
*Note.* Use mica-base antiseize compound (par. 8) on all pipe and hose connections, except pipe and hose unions. Use mica-base antiseize compound sparingly to prevent its entry into the inside of the pipes and hoses.

*b.* Install, in the order named, a  $1\frac{1}{4}$ -inch close nipple, a  $1\frac{1}{4}$ - to 1-inch reducing elbow, and a 1-inch hose union into the outlet (pressure) side of the hydraulic pump. Tighten the fittings securely and set the elbow so that it points straight upward.

*c.* Position the two hydraulic-pump mounting plates (already installed in the hydraulic-pump mounting base, par. 15) so that the hydraulic-pump support will rest properly upon them. Lower the hydraulic pump into position on the mounting plates, with the hydraulic-pump driven pulley at the forward end. Secure the pump

support to both mounting plates, using two bolts with lock washers for each plate. Do not tighten the screws enough to prevent the entire assembly from sliding easily in the grooves of the mounting base.

d. Loosen the hydraulic-pump adjusting screw (rotate counter-clockwise) sufficiently (fig. 19) to install the three belts of the hydraulic-pump belt set in the grooves of both the hydraulic-pump drive pulley and the hydraulic-pump driven pulley.



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*Figure 19. Adjusting hydraulic-pump belt tension.*

e. Tighten the hydraulic-pump adjusting screw (rotate clockwise) to move the hydraulic-pump support away from the drive pulley, until the tension of the three belts is such that finger pressure at the top center of each belt will result in approximately a  $\frac{1}{2}$ -inch belt deflection. Secure this adjustment by tightening (rotate clockwise) the nut on the adjusting screw. Now, tighten the four bolts which secure the hydraulic-pump support to the two hydraulic-pump mounting plates.

## **19. Installation of Interior Hydraulic Lines**

a. From the hydraulic reservoir, remove the outlet pipe flange and gasket by removing three cap screws and copper washers.

b. On one end of the rubber hose—7323372, assemble, first a  $1\frac{1}{2}$ -inch 90° elbow, then a  $1\frac{1}{2} \times 9\frac{1}{2}$ -inch nipple. On the other end of the hose,



in the order named, assemble a 1½-inch 90° elbow, a 1½-inch close nipple, and the outlet-pipe flange. Tighten all fittings securely.

c. Cement the outlet-pipe flange to reservoir gasket to the flange.

d. Position the foregoing hose under the vehicle propeller shaft (fig. 20) and mount the outlet-pipe flange to the hydraulic reservoir, using the three cap screws and copper washers which originally held it. Connect the 9½-inch nipple (at the free end of the hose assembly) to the elbow union already installed at the inlet side of the hydraulic pump.

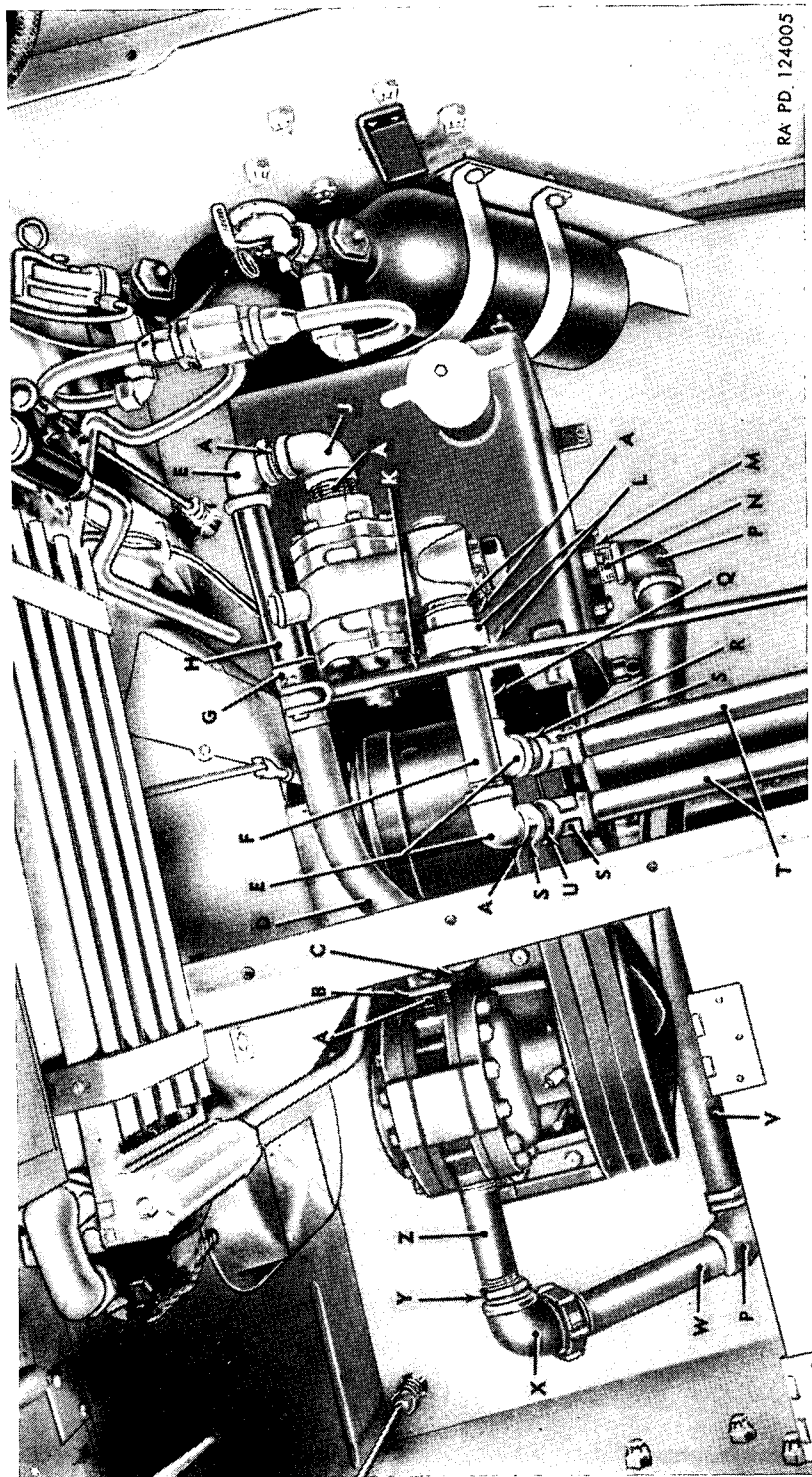
*Note.* Make certain that the hose clears all moving parts of the vehicle and the pump. It may be necessary to turn the elbow at the tank end upward by 10° to 15° to raise the hose up from moving parts beneath it. Also, to stretch the hose out and keep it from rubbing the pulleys or belts, it may be necessary to replace the 1¼ x 2½-inch nipple (that was installed at the inlet side of the pump) with a longer nipple of 6 or 7 inches.

e. The hydraulic-pump valve has six threaded openings in that portion of the valve which projects from the front, four of which are closed by plugs. Move the plugs, if necessary, so that the two openings at front and the two on the left side are tightly closed. Into each of the two openings on the right side (fig. 20), install a 1-inch close nipple and a 1-inch pipe union. Tighten all fittings securely.

f. There is also a threaded port on the left side of the hydraulic-pump control valve (fig. 20), opposite the control-rod to valve stem head link. Into this port install, in the order named, a 1¼-inch close nipple, a 1¼- to 1-inch 90° reducing elbow, a 1-inch close nipple, and a 1-inch 90° elbow. Tighten all fittings securely, positioning the first elbow to point straight to the rear and the second elbow to point straight to the right.

*Figure 20. Hydraulic pump, control valve, and oil reservoir lines.*

A—1¼ x 1½-INCH PIPE NIPPLE	N—1½ x 1¾-INCH PIPE NIPPLE
B—1¼ x 1-INCH 90-DEGREE REDUCING-PIPE ELBOW	P—1½-INCH 90-DEGREE STRAIGHT PIPE ELBOW
C—1-INCH UNION	Q—1 x 3-INCH PIPE NIPPLE
D—RUBBER HOSE—7323841	R—1 x 2½-INCH PIPE NIPPLE
E—1-INCH 90-DEGREE STRAIGHT PIPE ELBOW	S—1-INCH 45-DEGREE STRAIGHT PIPE ELBOW
F—1 x 6-INCH PIPE NIPPLE	T—HYDRAULIC-CYLINDER INLET AND OUTLET REAR PIPES
G—1-INCH STRAIGHT PIPE RH COUPLING	U—1 x 1½-INCH CLOSE PIPE NIPPLE
H—1 x 5½-INCH PIPE NIPPLE	V—RUBBER HOSE—7323372
J—1 x 1½-INCH 90-DEGREE REDUCING PIPE ELBOW	W—1½ x 9½-INCH PIPE NIPPLE
K—CONTROL-VALVE CONTROL ROD	X—1½-INCH 90-DEGREE UNION ELBOW
L—1-INCH PIPE UNION	Y—1½ x 1¼-INCH SHOULDER-PIPE BUSHING
M—OIL-RESERVOIR OUTLET PIPE FLANGE	Z—1¼ x 2½-INCH PIPE NIPPLE



*g.* Onto one end of the rubber hose—7323841 assemble, first a 1-inch coupling, then a 1 x 5½-inch nipple. Tighten all fittings securely.

*h.* Assemble the foregoing hose assembly to the hydraulic-pump control valve by connecting the 5½-inch nipple to the second 90° elbow in the group of fittings installed at the left side of the valve. Tighten securely. Now connect the free end of the hose to the hose union already installed at the outlet side of the pump. Tighten the union securely but do not twist the hose.

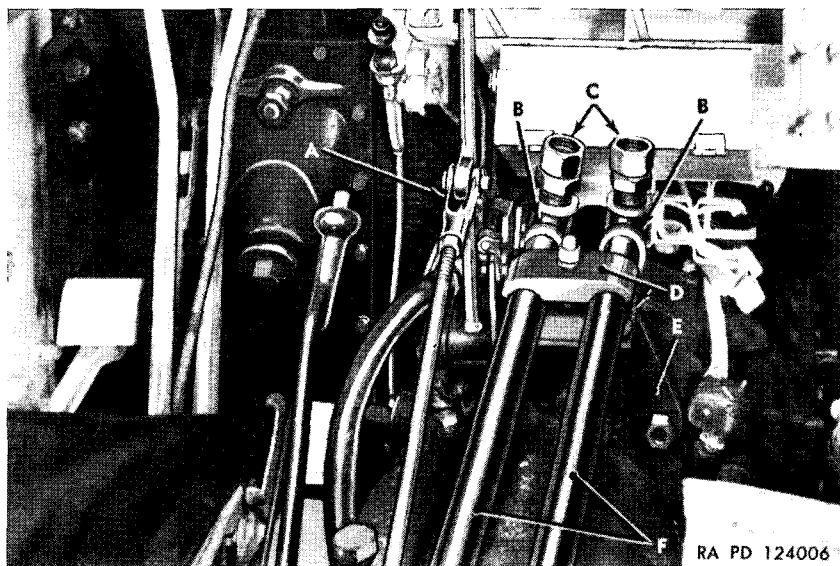
*i.* The two identical hydraulic-cylinder inlet and outlet rear pipes each have a figure “S” bend which is closer to one end than to the other. That end to which the bend is closer is the front end of each pipe. This front end (as shipped) holds the operating-lever shaft supporting bracket, with the control-valve operating lever, control rod, and two pipe clamps attached. Remove the nut and lock washer from the bolt, and separate the bracket, operating lever, and clamps from the two pipes. Also, disconnect the control rod from the operating lever. Onto the front end of each pipe install, first a 1-inch 90° elbow, then a 1-inch hose union. Tighten fittings securely.

*j.* At the rear end of one of the two rear pipes, assemble, in the order named, a 1-inch 45° elbow, a 1-inch close nipple, a 1-inch 90° elbow, and a 1 x 3-inch nipple. Tighten fittings securely, then connect the nipple to the bottom one of the two pipe unions already installed on the right side of the hydraulic-pump control valve. Arrange the pipe assembly (figs. 20 and 21) so that the rear pipe extends forward approximately along the center line of the vehicle.

*k.* At the rear end of the other rear pipe, assemble, in the order named, a 1-inch 45° elbow, a 1-inch close nipple, a 1-inch 45° elbow, a 1 x 2½-inch nipple, a 1-inch 90° elbow, and a 1 x 6-inch nipple. Tighten all fittings securely, then connect the 6-inch nipple to the top one of the two pipe unions already installed on the right side of the hydraulic-pump control valve. Arrange the assembly (figs. 20 and 21) so that the rear pipe extends forward, parallel to the other rear pipe.

*l.* Remove the uppermost stud-bolt nut from the rear side of the vehicle transmission housing; and also the nut to the right of the uppermost one. Use the bolts and nuts to attach the operating-lever shaft supporting bracket (fig. 21), with the control-valve operating lever attached to it (as shipped), to the transmission housing.

*Note.* As the stud bolts are too short to take the bracket and original nuts, together with the original washers, it is necessary to omit the washers when installing the nuts. It may be necessary to grind off the bottom edge of the bracket in order to fit the bolt holes over the bolts; and it may also be necessary to grind off the bottom front corner on the left side of the bracket (at left of operating lever) so that the bracket will clear the vehicle speedometer coupling located at this position.



- A—CONTROL-ROD ADJUSTABLE CLEVIS
- B—1-INCH 90-DEGREE PIPE ELBOWS
- C—1-INCH HOSE UNIONS
- D—PIPING CLAMPS
- E—CONTROL-VALVE-OPERATING LEVER BRACKET
- F—HYDRAULIC-CYLINDER INLET AND OUTLET REAR PIPES

*Figure 21. Hydraulic-cylinder inlet and outlet lines.*

*m.* Using the clamps, bolt, lock washer, and nut removed in *i* above, secure the front ends of the two hydraulic-cylinder inlet and outlet rear pipes to the operating-lever shaft supporting bracket (fig. 21).

*n.* Connect the bottom ends of the two hoses hanging down from the hydraulic-cylinder inlet and outlet pipe adapter (fig. 13) to the hose unions at the front ends of the hydraulic-cylinder inlet and outlet rear pipes. Connect the right hose to the right pipe; and the left hose to the left pipe. Tighten all connections, but do not twist hoses.

*o.* If removed, install the control-valve operating lever to the the operating-lever shaft supporting bracket, using the screw (fig. 43), operating-lever shaft (which fits inside the sleeve at bottom of lever), lock washer, and nut provided.

p. Install the control rod, connecting the nonadjustable clevis end to the control-rod to valve stem head link on the hydraulic-pump control valve.

q. Set the control valve by rotating the control-rod to valve stem head link to engage a detent inside the valve. There will be a distinct "settling" in the "feel" of the link when it reaches this position, from either direction of rotation.

r. Place the control-valve operating lever at the "HOLD" position (indicated on the lever instruction plate), and lock it there by rotating the operating-lever rear lock to the left, to engage the operating lever.

s. Adjust the adjustable rod end yoke at the front end of the control rod (fig. 21) so that it can be connected to the operating lever without moving the control-rod to valve stem head link on the control valve. Then connect this yoke to the operating lever.

*Note.* Locating the "HOLD" position in this manner automatically locates all the other control-valve positions.

t. Install the vehicle collector ring and the left floor support angle that extends through the center of the vehicle interior; but do not install the left forward bolt which holds the collector-ring housing.

u. Install the control-rod guide bracket to the left floor support angle so that it hangs down with the flat side against the angle, and is held by the same bolt which holds the left forward corner of the collector-ring housing.

v. Place the control-rod guide over the control rod, and bolt it to the control-rod guide bracket, using the two bolts, lock washers, and nuts provided.

*Note.* Before, and again after, tightening the nuts, test operate movement of the control rod and bend the rod as required to insure free movement when the guide is tight.

## **20. Installation of Hydraulic Cylinders**

a. Remove the caps from the three hydraulic-cylinder brackets. Observe the locating marks on the caps, which indicate the brackets with which they mate and their correct positions on the brackets.

*Note.* The caps are not interchangeable; each must be installed on the proper bracket, and in the original position.

b. Remove the two hydraulic cylinders from the moldboard assembly (C, fig. 7) by taking out the pin which holds the piston-ram eye of each cylinder to the lift link. Each pin is secured by a bolt and lock washer.

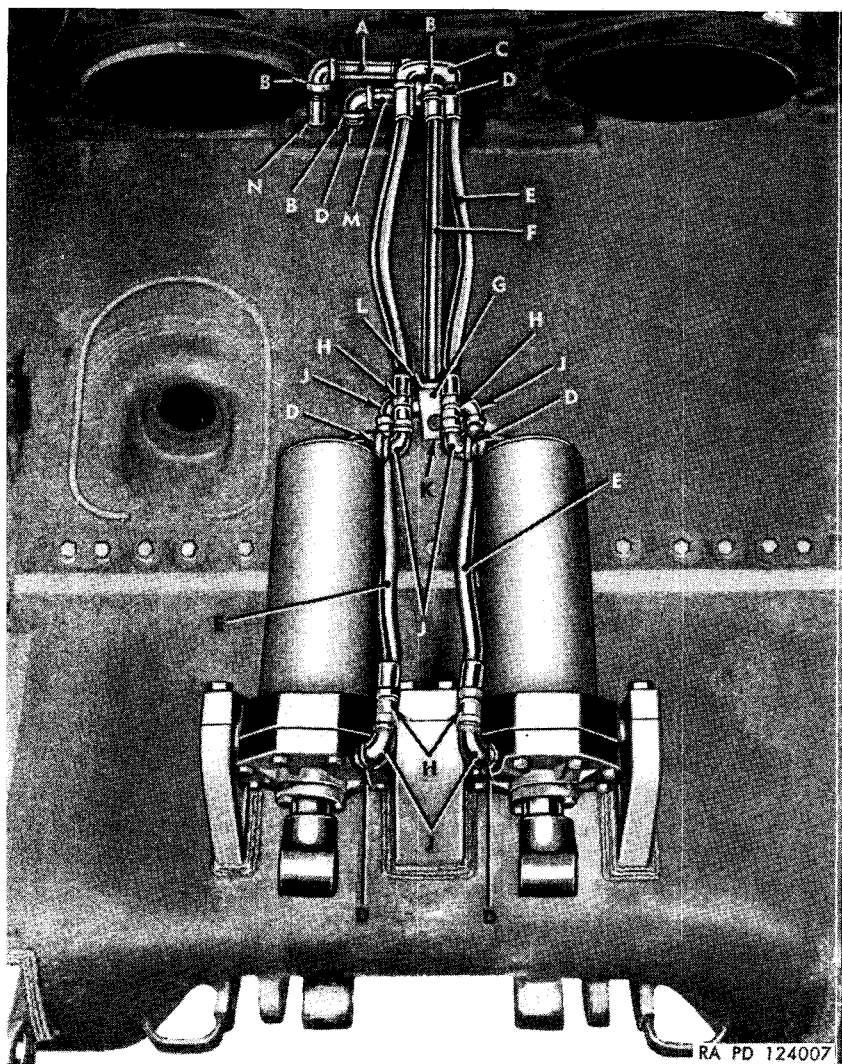
c. Near the top of each hydraulic cylinder there is a threaded opening; and there is another threaded opening near the bottom. The top openings are the outlet openings; those at the bottom are the inlet openings. Into each of the four openings (fig. 22) install, in the order named, a 1-inch close nipple, a 1- to  $\frac{3}{4}$ -inch 90° elbow, and a  $\frac{3}{4}$ -inch hose union. Tighten all fittings securely, pointing all four elbows toward the tops of the cylinders.

*Note.* The right cylinder is that one having the fittings on the left side; the left cylinder has the fittings on the right side.

d. Place the hydraulic cylinders in the brackets, the right cylinder on the right, the left cylinder on the left. Then install the bracket caps, properly positioning each one with respect to the locating marks (a above). Tighten the bolts securely and uniformly.

e. Into the left opening of the hydraulic-cylinder inlet and outlet pipe adapter (opening on right when facing the front of the vehicle) assemble, in the order named, a 1-inch close nipple, a 1-inch 90° elbow, a 1 x 5-inch nipple, a 1-inch 90° elbow, a 1-inch close nipple, a 1-inch 45° elbow, the hydraulic-cylinder inlet front pipe, the 1 x 1 x 1-inch pipe tee, then into each side of the tee, install a 1-inch close nipple, a 1 to  $\frac{3}{4}$ -inch 90° reducing elbow, and a rubber hose 7323362. Tighten all fittings securely to place the assembly on the vehicle in the position shown in figure 22. Then connect the free ends of the two hoses to the inlet (bottom) hose unions already installed on the two cylinders. Tighten unions securely but do not twist hoses.

f. Into the remaining opening of the hydraulic-cylinder inlet and outlet pipe adapter, assemble, in the order named, a 1 x 4-inch nipple, a 1-inch 90° elbow, a 1 x 7-inch nipple, the reducing Y fitting (a special 1 x  $\frac{3}{4}$  x  $\frac{3}{4}$ -inch fitting), then, into each side of the Y fitting, install one of the rubber hoses—7323362. Tighten all fittings securely to place the assembly on the vehicle in the position shown in figure 22. Then connect the free ends of the two hoses to the outlet (top) hose unions already installed on the two cylinders. Tighten unions securely but do not twist hoses.



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- A—1 x 7-INCH PIPE NIPPLE
- B—1-INCH 90-DEGREE ELBOW
- C—REDUCING Y FITTING
- D—1 x 1½-INCH CLOSE-PIPE NIPPLE
- E—RUBBER HOSE—7323362
- F—HYDRAULIC-CYLINDER INLET FRONT PIPE
- G—INLET-PIPE TEE CLAMP PLATE
- H—¾-INCH UNION
- J—1 x ¾-INCH REDUCING-PIPE ELBOW
- K—MOUNTING BLOCK
- L—1 x 1 x 1-INCH PIPE TEE
- M—1 x 5-INCH PIPE NIPPLE
- N—1 x 4-INCH PIPE NIPPLE

*Figure 22. Hydraulic cylinders and lines.*

## 21. Filling Hydraulic System with Oil and Checking Cylinder Operation

*a.* Remove the hydraulic-oil-reservoir filler cap (fig. 17) and fill the reservoir with hydraulic oil (OH). The total capacity of the hydraulic system is approximately 16 gallons.

*b.* Start the vehicle engine (TM 9-759) and operate the control-valve operating lever (par. 43) to move the cylinder rams up and down several times so that air will be forced out of the hydraulic system.

*c.* Bring the oil level in the reservoir up to the drain cock.

*Note.* Oil level can be checked by opening the cock slightly to let several drops spill out when correct level is reached.

*d.* Before turning engine off, run the hydraulic-cylinder piston rams all the way down (out of cylinders). Leave them thus, and turn engine off.

## 22. Installation of Front Tow Hooks

*a.* Unless the front tow hooks were previously installed (par. 11), they should be installed at this time.

*b.* The tow hooks are now installed with new 1½ x 7-inch straight pins, which will be held in place by the pins in the lift-link brackets (installed later), and will not require pin locks.

## 23. Installation of Lift Link

*a.* Using a hoist, swing the lift link into position (fig. 23) in front of the vehicle.

*Note.* Two cables should be used to hold lift link perfectly horizontal and facilitate attaching it to the vehicle.

*b.* With the lift link raised to proper height, swing the bottom end in toward the vehicle to engage the bottom rear pair of brackets (on the link) with the lift-link brackets welded to the vehicle. Insert the two pins, pushing each through from the inside toward the outside, and secure the pins with bolts and lock washers.

*c.* Lower the lift link to the ground, disengage the hoist cables, then refasten the cables to the pairs of brackets at the bottom front of the lift link.

*d.* Elevate the lift link, using the hoist, until the two pairs of brackets on top are engaged with the respective hydraulic-cylinder piston ram eyes. To manage proper engagement of each pair of brackets with the proper ram eye, it may be necessary to position the ram eye by inserting a crowbar under the top of the hydraulic cylinder and



raising the top slightly. As each pair of brackets and ram eye are engaged, insert the connecting pin. These pins are inserted from the outside toward the inside. Each pin is secured by a bolt and lock washer.

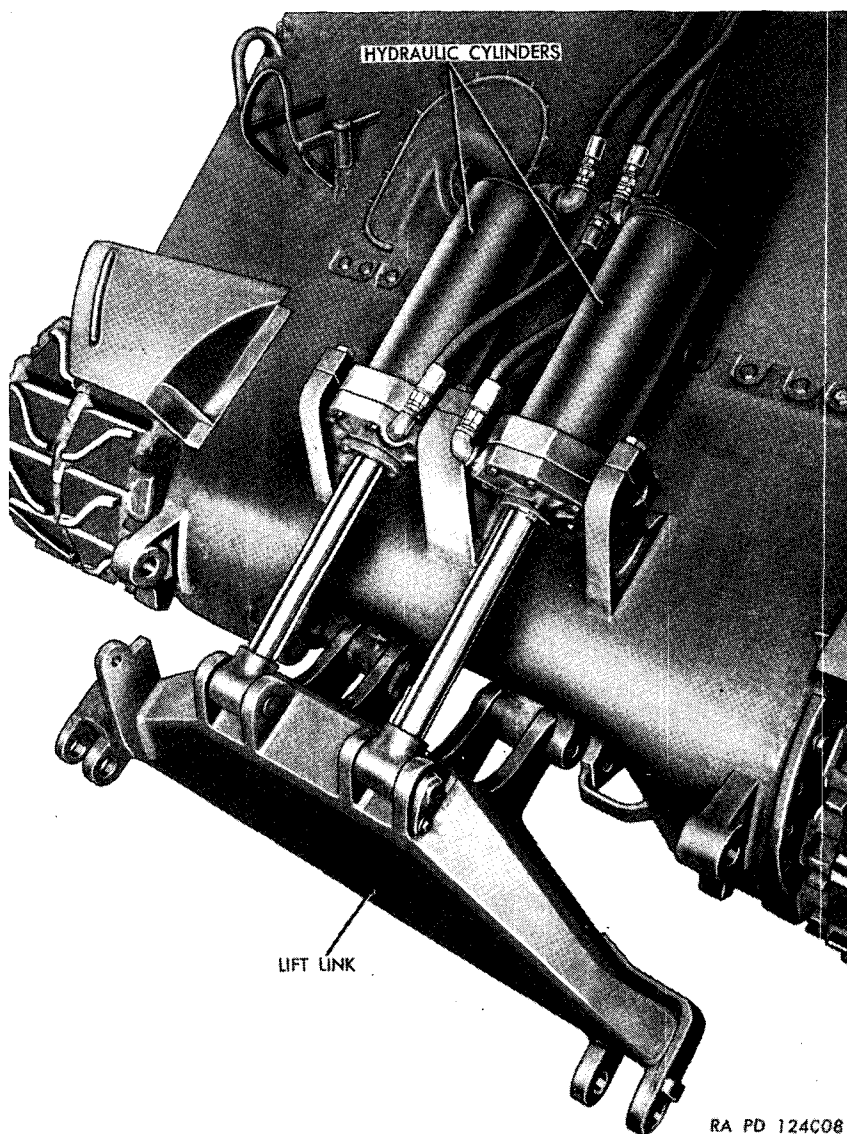
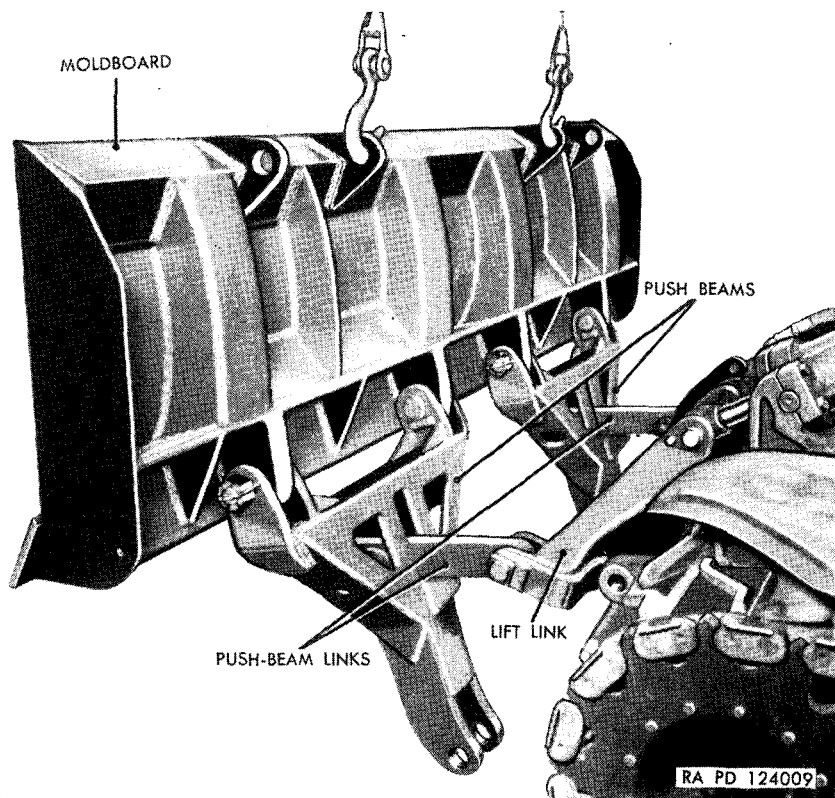


Figure 23. Lift link installed.

e. Attach the two push-beam links to the pairs of brackets at the bottom front of the lift link (figs. 24 and 25). The ends of the links

having built-up bosses around the bores are the ends engaged with the lift link. Each link is secured by a pin having a slotted nut and split cotter pin. Pins are inserted from the outside toward the inside.



*Figure 24. Moldboard partially installed.*

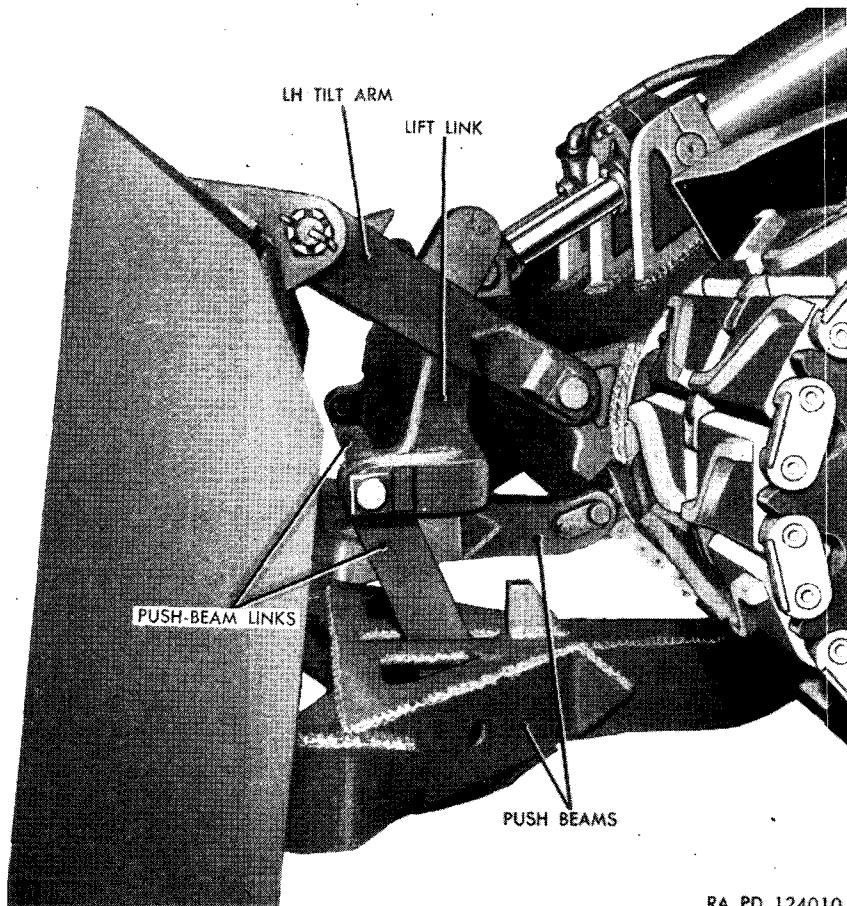
## **24. Installation of Moldboard**

*a.* Start the vehicle engine and operate the control-valve operating lever (par. 43) to raise the lift link all the way up. "HOLD" the link in this position.

*b.* Remove the two tilt arms (fig. 25) from the moldboard assembly (C, fig. 7) by taking out the one long pin, with slotted nut and split cotter pin, which attaches each one.

*c.* Attach the two cables of a hoist sling to the tilt-arm brackets on the top rear edge of the moldboard (fig. 24) so that the moldboard will be horizontally suspended when raised up, then position the moldboard squarely in front of the vehicle with the bottom edge just touching the ground.

d. Check to make certain that the two push beams are correctly and securely attached to the moldboard. (These are shipped attached, as part of the moldboard assembly (C, fig. 7) and have not been removed.) Each push beam is connected to the moldboard with two pins held by slotted nuts with split cotter pins. The pins for each



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*Figure 25. Moldboard installed.*

push beam are inserted from inside the push-beam yoke towards the outside. Each push beam, when correctly installed, has the small projecting boss (which is approximately at the center of the beam) on the top side of the beam; and each has the large diameter opening (which is in one side of the beam opposite a small diameter opening in the other side) on the inner side.

e. Have a separate operator handle each push-beam link (fig. 24) and elevate the moldboard, then jockey it in front of the vehicle until the free ends of these push-beams links are dropped down through

the top center slots of the respective push beams and until the link ends are properly engaged in these push-beam slots. Each link is connected to the associated push beam by a pin and slotted nut with a split cotter pin. The pins are inserted through the large diameter openings on the inner sides of the push beams, and thrust outward; and the nuts can be put onto the pins by reaching down through the top openings in the push beams.

*f.* Lower the moldboard to the ground and allow it to rotate backward against the lift link to create slack in the hoist cables; then unhook one end of the hoist sling and hook it to the same side of the moldboard with the other end of the hoist sling. (With both sling ends at one side, one pair of tilt-arm brackets will be free for attachment of the tilt arm on this side.)

*g.* Raise the moldboard into an upright position with the bottom edge just touching the ground, and install one tilt arm at the "free" side of the moldboard. When properly installed, each tilt arm has the projecting boss (which holds the carrying-hooks engagement pin) on the top of the arm and on the inner side. Each arm is connected to the moldboard by a long pin, inserted from the inner side toward the outer side and secured by a slotted nut with a split cotter pin.

*h.* Jockeying the moldboard into position by means of the hoist attached to the other end, align the small end of the tilt arm just installed with the associated tilt-arm bracket welded to the vehicle (fig. 25). When properly aligned, connect the arm to the bracket by means of a pin, inserted from the outer side toward the inner side, held by a slotted nut with a split cotter pin.

*Note.* It will be helpful to reposition the lift link, as required, by operation of the bulldozer drive.

*i.* After installing the first tilt arm, disconnect the hoist sling from the bulldozer, and use the control-valve operating lever (par. 43) to jockey the moldboard for installation of the second tilt arm. Install this second tilt arm (*g* above).

*j.* Use the control-valve operating lever to lower the moldboard, and continue lowering it until the hydraulic-cylinder piston rams are fully extended. If the ground or floor in front of the vehicle is (as it should be) sufficiently hard, the blade will not be able to enter the ground, and lowering of the moldboard to this extent will raise the front of the vehicle up approximately 12 inches. Block the vehicle up in this position, then elevate the moldboard just enough for the blade to be free of the ground so as to permit swinging the lower end of the moldboard backward into the front of the vehicle.

*k.* Place two operators in front of the moldboard to push the lower end toward the vehicle. Place another operator under the front of

the vehicle, between the two push beams and furnish this operator with a hydraulic jack. Also have an operator at the control-valve operating lever.

l. Push the bottom of the moldboard into the front of the vehicle, simultaneously elevating the free end of one push beam (the hydraulic jack will aid in this part of the operation) and, also, simultaneously using the control-valve operating lever to jockey the push-beam end into alinement with the associated push-beam bracket welded to the vehicle. When the push beam is alined with the bracket, attach it with a pin, inserted from the inside toward the outside. Secure the pin with a bolt and lock washer.

**Warning:** Keep legs and arms out from under the moldboard.

m. Attach the second push beam to the vehicle in the same manner.

n. Recheck all pin fastenings to make certain pins are properly tightened and, where used, secured by split cotter pins through the attachments.

*Note.* This completes installation of the moldboard, as shown in figure 25. The bulldozer is now ready for normal operation, even though the emergency-lift equipment and carrying hooks are yet to be installed.

## 25. Test Operation of Bulldozer

a. Start the vehicle engine (TM 9-759) and operate the control-valve operating lever (par. 43) to raise and lower the moldboard through its entire range.

b. While operating the lever, have additional operators check all hydraulic-oil lines—especially at connections—for leaks. If any leaks are discovered, affected lines must be disassembled and installed with mica-base antiseize compound, to stop leakage. Leaks at pipe or hose couplings can generally be stopped by tightening the couplings.

c. Also, while operating the lever, check all linkages to make certain that moldboard will raise and lower through its entire range, without binding or interference at any point.

d. Place the operating lever at “HOLD” with moldboard elevated approximately halfway. Keep lever in this position for 5 minutes while noting whether moldboard is maintained in its position without movement, or whether it drops slowly toward the ground. If moldboard drops slowly toward the ground, refer to paragraph 57.

e. Place operating lever at “FLOAT,” and hold it there while observing moldboard. Moldboard should settle slowly and steadily until bottom is resting on the ground. If there is any upward movement, or any downward movement after moldboard has settled to the ground, refer to paragraph 57.

f. Check oil level in the hydraulic-oil reservoir. Level should still

be high enough for a few drops to run out the drain cock (fig. 17), when opened. If not, add hydraulic oil (OH).

## 26. Installation of Carrying-Hooks Shaft

a. Have two operators hold the carrying-hooks shaft (T, fig. 7) (which is shipped fully assembled with the hooks and brackets on the shaft) horizontally against the front of the vehicle hull. The flat base of the two brackets must be against the hull (fig. 26); and the open sides of the two hooks must be facing down.

*Note.* It will be easier to position this shaft assembly on the hull if the mold-board is partially lowered.

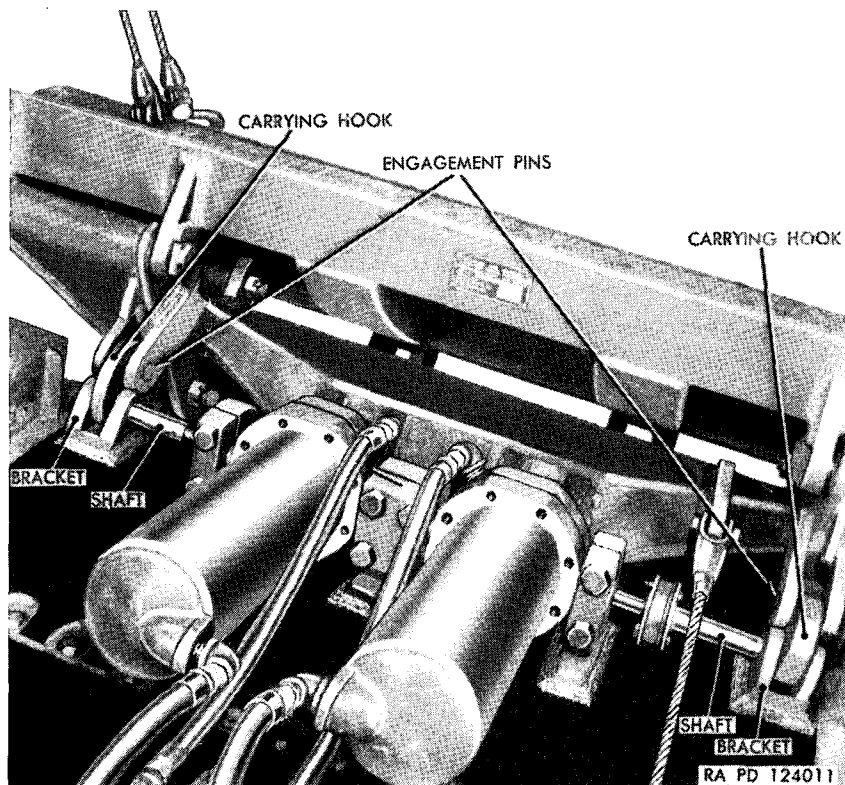


Figure 26. Carrying-hook shaft.

b. Raise the moldboard as high as it will go and "HOLD" it there.

c. Engage the two hooks of the shaft assembly over the respective carrying-hooks engagement pins (on the tilt arms), and maneuver the shaft until the hooks will freely engage and disengage the pins while the two brackets are pressed firmly against the hull.

*d.* Tack weld the brackets to the hull at two points each; then again engage and disengage the hooks to make certain they operate freely.

*Note.* If the hooks bind, or if there is insufficient clearance between the pins and the hook ends for the hooks to properly slip over and engage the pins, break the tacking and repeat steps *c* and *d* above.

*e.* When certain that the shaft is properly positioned, lower the moldboard to the ground, turn off the vehicle engine (TM 9-759), and complete welding each bracket to the hull with a  $\frac{5}{8}$ -inch weld all around.

**Caution:** Whenever vehicle engine is operating and carrying hooks are engaged, be careful not to move the control-valve operating lever to "DOWN," as this would damage the equipment. If it is necessary to move the lever from "RAISE" or "HOLD" to "FLOAT," move it quickly past the "DOWN" position.

## **27. Installation of Hydraulic-Piping Guards**

*a.* Raise the hydraulic-piping lower guard into place (fig. 27) over the hydraulic cylinders, and attach the sides of the guard to the cylinder outer brackets with a bolt, lock washer, five plain washers, a lock washer, and a nut (in the order named) at each side. Before tightening the nuts, slide the guard up as far as necessary on the vehicle's hull to give ample clearance between the lower end of the guard and the carrying-hooks shaft. Tighten nuts.

*b.* Locate two mounting blocks under the two lugs at the upper end of the guard, and start two bolts into these blocks to properly locate them in place.

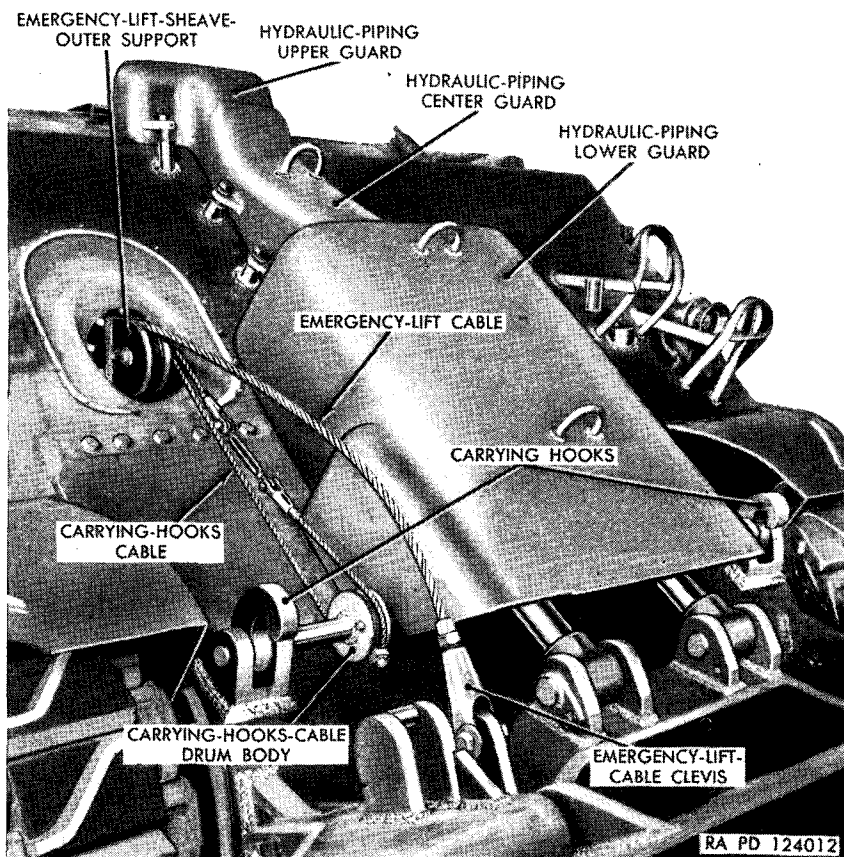
*c.* Raise the hydraulic-piping center guard (fig. 27) into place over the piping above the lower guard. The bottom of this guard should rest squarely against the top of the lower guard.

*d.* Locate four mounting blocks under the four lugs on this center guard, and start four bolts into the blocks to properly hold them in place.

*e.* Raise the hydraulic-piping upper guard (fig. 27) into place over the piping at the top of the vehicle hull. The bottom of this guard should rest against and mate with the top of the center guard.

*f.* Locate three mounting blocks (one with a bevel-cut bottom) under the three lugs on this upper guard, and start three bolts into the blocks to properly hold them in place.

*g.* Recheck positions of all three guards. They should be neatly fitted together and flush against the vehicle hull at all points.



*Figure 27. Emergency-lift cable and hydraulic-piping guards installed.*

*h.* Tack weld the nine mounting blocks to the vehicle hull, checking each one prior to welding to make certain it is positioned squarely under the lug above it.

*i.* Remove all three guards and finish welding the nine mounting blocks to the hull, using a  $\frac{1}{4}$ -inch weld around each one.

*j.* Install the three guards, using a lock washer under each bolt screwed into the mounting blocks, and again bolting the lower guard to the hydraulic-cylinder brackets (*a* above). Tighten all bolts securely.

## **28. Replacement of Vehicle Parts on Exterior**

*a.* Locate a new tow-cable clamp in a position to the left of the piping guards, and weld it to the vehicle hull.



b. Modify the two base brackets (76-mm gun-traveling-lock hinge blocks) removed from the front of the vehicle (par. 10) by cutting and grinding as shown in figure 28.

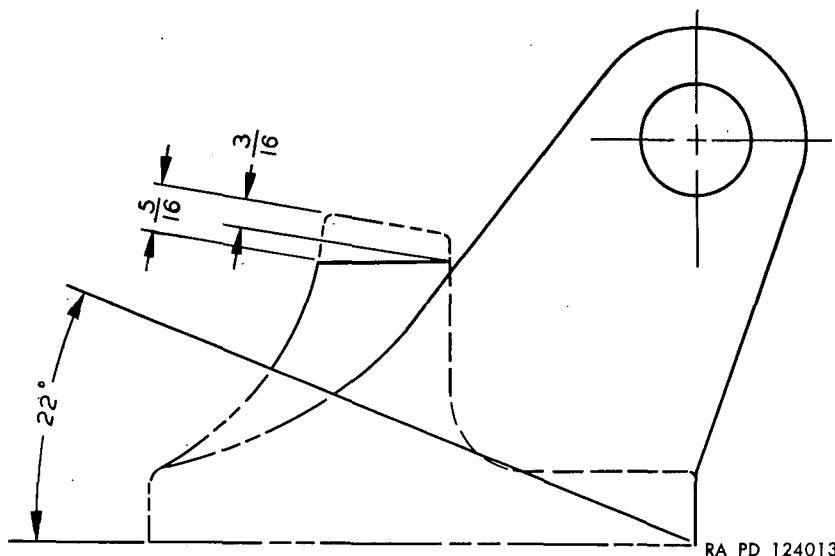
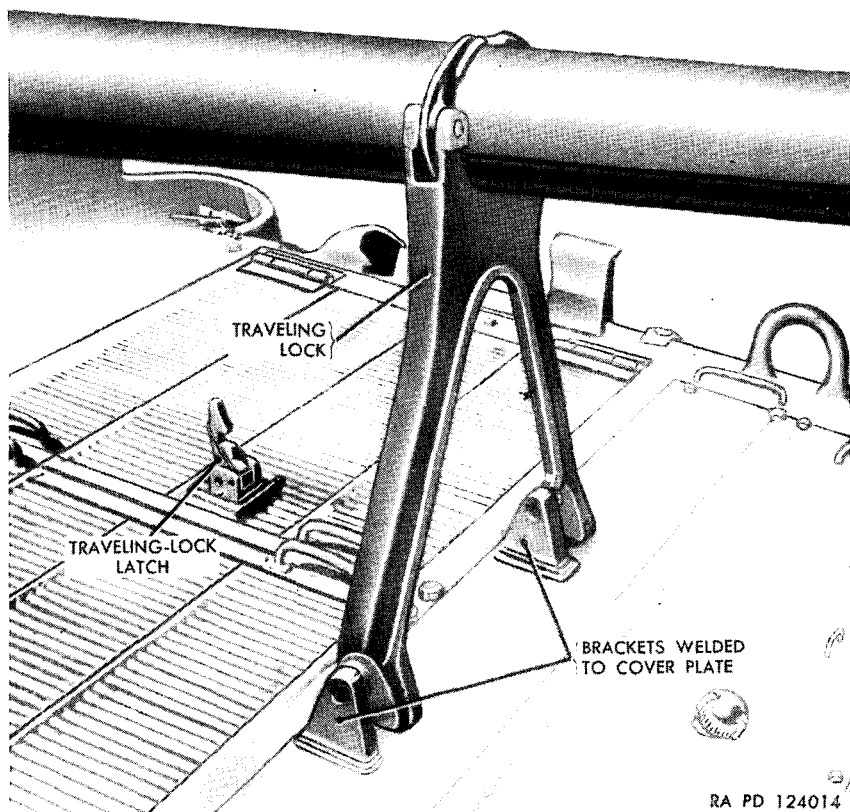


Figure 28. Modification of bracket for gun-traveling-lock hinge block.

c. Using the traveling lock as a template, locate and weld the hinge blocks to the engine cover plate (fig. 29).

d. Lower the traveling lock and locate the traveling-lock latch on the engine grille (fig. 29), and weld it in place.

e. Make a cutout in the flange of each front fender splash guard to clear the weld around the adjacent carrying-hooks shaft bracket, then install the two front fenders and two splash guards.



*Figure 29. Gun-traveling lock in new position.*

## **29. Installation of Moldboard Lifting Emergency-Lift Jack**

*a.* Disconnect the emergency-lift cable from the emergency-lift jack (**K**, fig. 7) by removing the cap screw and lock washer, and taking out the emergency-lift jack and cable-connector pin that holds the emergency-lift cable connector to the emergency-lift sheave inner support (to which the jack is also attached).

*b.* Take out the eight screws, nuts, and lockwashers which attach the emergency-lift sheave outer support to the inner support, and separate these two supports.

*c.* Have one operator insert the inner support—with the jack attached and hanging down (fig. 30)—into the vehicle machine gun port, on the inside of the vehicle. Aline the bolt holes with those around the gun port, and hold the support in this position.

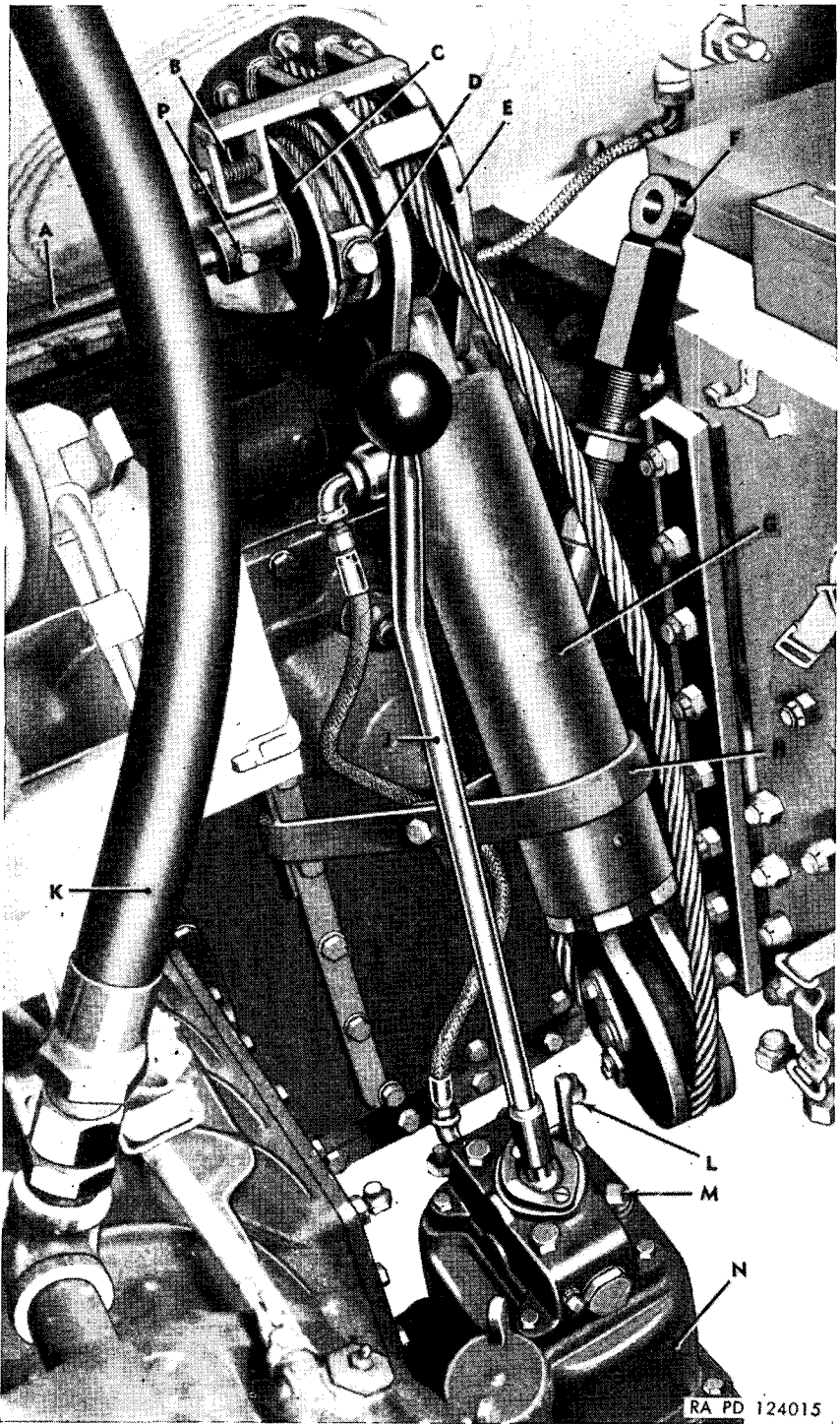


Figure 30. Emergency-lift components.

Figure 30—Continued.

A—HAND-CONTROL SHAFT  
B—HAND-CONTROL-SHAFT CABLE DRUM PIN WITH COMPRESSION SPRING  
C—CARRY-HOOKS CABLE DRUM  
D—CARRYING-HOOKS CABLE DRUM-BLOCK  
E—EMERGENCY-LIFT SHEAVE INNER SUPPORT  
F—EMERGENCY-LIFT CABLE CONNECTOR (ANCHOR END)  
G—MOLDBOARD-LIFTING EMERGENCY-LIFT JACK  
H—EMERGENCY-LIFT JACK SUPPORT BRACKET  
J—EMERGENCY-LIFT PUMP OPERATING LEVER  
K—RUBBER HOSE  
L—EMERGENCY-LIFT PUMP RELEASE-VALVE LEVER  
M—EMERGENCY-LIFT PUMP OIL-RESERVOIR FILLER PLUG  
N—EMERGENCY-LIFT PUMP  
P—CABLE DRUM HAND-CONTROL SHAFT PIN

d. Have another operator insert the outer support into the machine-gun port on the outside of the vehicle (fig. 27). The smaller sheaves at one side of this support face the center of the vehicle. Aline the bolt holes with those around the gun port, and hold the support in this position.

e. Connect the outer support to the inner support by passing the eight screws (removed in *b* above) from the outside toward the inside, and securing them with the eight lock washers and nuts.

f. Remove the two cap screws, lock washers, and nuts which secure the emergency-lift jack support bracket brace to the emergency-lift jack support bracket (AA fig. 7), and detach the brace.

g. There are two vertical rows of cap screws on the inside of the vehicle differential-carrier housing, immediately in front of the emergency-lift jack. Remove the second and third cap screws from the top of each vertical row.

h. Place the support bracket around the jack (fig. 30), and bolt it to the vehicle with the four cap screws removed in the preceding step. When properly positioned, the top of the bracket is nearly horizontal.

i. Reattach the brace to the bracket in front of the jack, using the two cap screws, lock washers, and nuts (removed in *f* above). When properly positioned, the brace will hold the jack rigidly in the position shown in figure 30.

j. Thread the plain end of the emergency-lift cable down between the jack ram emergency-lift cable sheave and the emergency-lift cable clip (at bottom front of the jack), turn the cable up around the sheave, then pass the plain end out of the vehicle (fig. 30) by threading it over the sheaves in the inner and outer supports.

k. Disassemble the emergency-lift cable clevis (which is shipped hanging onto the cable) by screwing the cable-end sleeve out of the clevis part, and lifting out the grooved plug.

l. Wrap the plain end of the cable with wire for a distance of  $\frac{1}{2}$  inch, at each of three places approximately  $\frac{1}{2}$  inch, 3 inches, and 6 inches from the end.

*m.* Push the cable-end sleeve, plain end first, over the cable end far enough to prevent the cable from fanning out, then remove the first wire wrap.

*n.* Insert a screwdriver blade into the center of the cable strands to spread them, pry out the hemp center, then cut the hemp center off just above the center wire wrap.

*o.* Push the cable-end sleeve down over the cable far enough to insert the grooved plug, pointed end first, among the cable strands, so that each strand lies in a groove of the plug.

*p.* Alternately tap the sleeve and the plug to drive them onto the cable until the lower end of the sleeve is approximately  $3\frac{5}{16}$  inches from the end of the cable. Drive the plug in so that it seats solidly.

*q.* Compress the protruding cable strands as necessary and screw the clevis part tightly back onto the sleeve.

*r.* Remove the nut and pin from the clevis, then use these to attach the clevis to the lug at the right side of the lift link.

*Note.* Do not draw the nut so tight on the pin that the clevis will not rotate freely on the pin.

*s.* Start the vehicle engine (TM 9-759) and lower the moldboard as far as it will go; then "HOLD" it there.

*Note.* If blade cannot dig-in, this will result in raising up the front of the vehicle.

*t.* From the inside of the vehicle, pull the emergency-lift cable tight, while also making certain that the emergency-lift jack is fully closed (ram all the way up in cylinder). Now, adjust the emergency-lift cable connector (at inside end of cable) by turning it down on, or up off of the threaded cable end until the connector can just be attached to the sheave inner support when the cable is as tight as it can be drawn; then attach the connector to the support, using the pin, lock washer, and screw (removed in *a* above).

*u.* Turn the nut—which is on the cable end—up tightly against the bottom of the connector, to lock the connector in position.

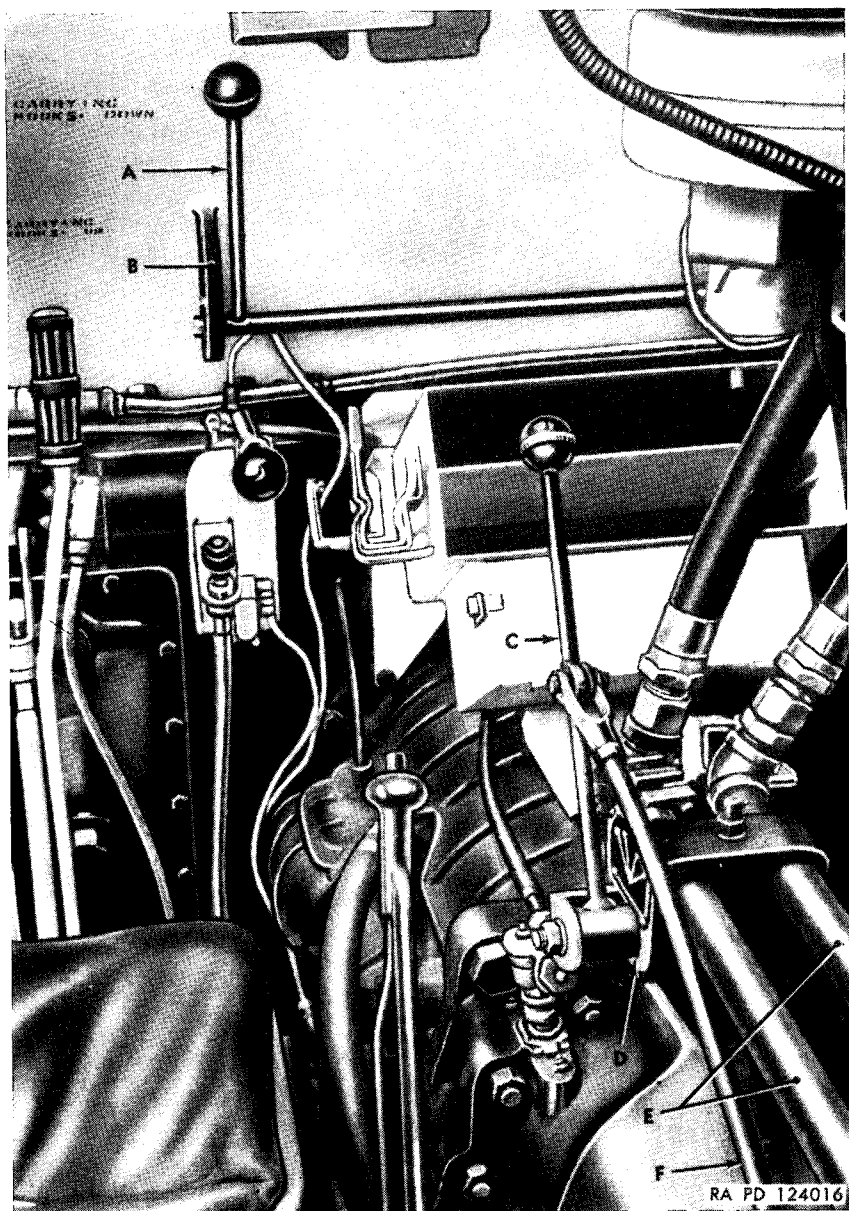
*v.* Place the control-valve operating lever at "FLOAT," turn the operating-lever front lock down around the lever to hold it, then turn off the vehicle engine (TM 9-759).

### 30. Installation of Hand-Control Shaft

*a.* Loosen the cap screw in the sleeve of the carrying-hooks cable drum (fig. 30), and install the hand-control shaft (M, fig. 7). The screw passes through the end of the shaft to thread into the opposite side of the sleeve, and the shaft is correctly positioned when the screw is horizontal and the lever at the shaft end is pointing upward.

*b.* Place the hand-control shaft bracket (U, fig. 7) over the outer end of the shaft (fig. 31) with a  $\frac{1}{8}$ -inch clearance between the bracket

and the lever portion of the shaft, line up the shaft with the center line of the drum, and weld the bracket to the hull with a  $\frac{1}{4}$ -inch weld all around.



- A—HAND-CONTROL SHAFT
- B—HAND-CONTROL SHAFT BRACKET
- C—CONTROL-VALVE OPERATING LEVER
- D—CONTROL-VALVE OPERATING-LEVER BRACKET
- E—HYDRAULIC-CYLINDER INLET AND OUTLET REAR PIPES
- F—CONTROL ROD

*Figure 31. Hand-control shaft and control-valve operating lever installed.*

## 31. Installation of Hand-Operated Emergency-Lift Pump

a. Remove the portable fire extinguisher and bracket.

b. Locate the emergency-lift pump, with the mounting plates attached (Z, fig. 7), on the floor of the assistant driver's compartment. The pump is properly positioned when the release-valve lever (fig. 30) is at the right. To properly locate the pump, place it  $13\frac{3}{4}$  inches from the right wall of the vehicle and approximately  $8\frac{1}{4}$  inches from the differential-carrier housing, in front. If a welded mounting plate of the fire extinguisher (to be found in some vehicles) interferes, the pump can be moved backward an inch or two. The important factor is to keep pump as much as possible out of the way of the assistant driver's feet, while having it accessible to him for hand operation.

c. Weld the pump mounting plates in place with a  $\frac{3}{8}$ -inch weld all around each plate.

*Note.* To make room for welding, remove the four cap screws and lock washers which secure the pump to the mounting plates and remove pump after tacking the plates in place. Mount pump onto plates after completing the welds.

d. Using the three screws originally used for fastening the fire-extinguisher bracket to the vehicle floor, assemble the bracket to the flat side of the fire-extinguisher mounting base (V, fig. 7), with the spacer under the plate on the open side of the extinguisher bracket.

e. Locate the bracket and base on the vehicle floor in the right front corner of the assistant driver's compartment, as far forward and to the right as possible, and in such a way that the fire extinguisher can be removed and inserted without interference.

f. Weld the fire-extinguisher mounting base to the floor with a  $\frac{1}{4}$ -inch weld all around.

g. Connect the fixed end of the rubber hose—7705042 to the street elbow (fig. 30) which is at the top left side of the emergency-lift jack. Tighten securely.

h. Connect the swivel end of this hose to the adapter which is located at the front center, near the top, of the emergency-lift pump. Tighten securely; but be careful not to twist the hose.

i. Using the pin with split cotter pin (to be found in the plunger-operating lever projecting up from the emergency-lift pump), mount the hand-operated operating lever, with knob attached (N, fig. 7), to the pump. The lever is properly positioned (fig. 30) when the top part angles backward.

j. Replace the portable fire extinguisher in its bracket.

## 32. Installation of Carrying-Hooks Cable

a. Thread the plain end of the carrying-hooks cable (P, fig. 7) from the outside to the inside of the vehicle by passing it over the top of

the outer one of the two small sheaves on the emergency-lift sheave outer support (fig. 27), then through the lower set of holes in the two sheave supports.

*b.* The cable end will enter the vehicle on the underside of the carrying-hooks cable drum (fig. 30). Remove the cable-drum block and wrap the cable one and one-half turns around the drum, then pass the end out of the vehicle through the upper set of holes in the two sheave supports, and over the top of the other (inner) small sheave attached to the outer support.

*c.* Pass the cable end over the drum on the carrying-hooks shaft, remove the cable-drum block, and wrap the cable one and one-half times around this drum.

*d.* Wrap the plain cable end with wire for a distance of  $\frac{1}{4}$  inch, in two places located approximately  $\frac{1}{2}$  inch and 3 inches from the end.

*e.* Disassemble the carrying-hooks cable end (which is shipped hanging onto the cable) by unscrewing the cable-end sheave out of the clevis part, and removing the pointed plug.

*f.* Push the sleeve, plain end first, over the cable end far enough to prevent the cable from fanning out, then remove the first wire wrap.

*g.* Insert a screw driver blade into the center of the cable strands to spread them, pry out the hemp center, then cut the hemp center off just above the second wire wrap.

*h.* Push the cable-end sleeve down over the cable far enough to insert the pointed plug, point first, among the cable strands.

*i.* Alternately tap the sleeve and the plug to drive them onto the cable until the lower end of the sleeve is approximately  $2\frac{3}{8}$  inches from the end of the cable. Drive the plug in so that it seats solidly.

*j.* Compress the protruding cable strands as necessary, and screw the clevis part tightly back onto the sleeve.

*k.* Open the carrying-hooks cable turnbuckle (already attached to one end of the cable) so that the cable will be slack, then attach the free cable end to the turnbuckle using the cap screw, lock washer, and nut in the clevis.

*l.* Start the vehicle engine (TM 9-759) and raise the moldboard to its extreme raised position.

*m.* Engage both carrying hooks with the carrying-hooks engagement pins, then move the control-valve operating lever to "FLOAT" so that the moldboard will settle down and be supported by the hooks in carrying position.

*Note.* Move the operating lever quickly through the "DOWN" position when placing it at "FLOAT."

*n.* Position the carrying-hooks cable, by slipping it on the drums, to place the upper cable end (at the top of the turnbuckle) approxi-



mately 3 inches down from the sheave outer support, then tighten the turnbuckle (rotate it clockwise) until all sag is taken out of the cable. Tighten the nuts at each end of the turnbuckle.

*o.* Clamp the cable to the drum on the carrying-hooks shaft by installing the cable-drum block (fig. 27), using the lock washer and cap screw which attach it. Be careful to insert the screw between the two coils of the cable on the drum.

*p.* Position the hand-control shaft with the lever upward (fig. 31) so that the cable-drum hand-control shaft pin (fig. 30) engages the detent in the side of the cable drum.

*Note.* If lever was down, this will necessitate slipping the drum inside the loops of the cable wrapped around it, as the cable cannot now be moved in either direction.

*q.* Clamp the cable to the drum on the hand-control shaft by installing the cable-drum block (fig. 30), using the lock washer and cap screw which attach it. Be careful to insert the screw between the two coils of cable on the drum.

*r.* Move the control-valve operating lever to "RAISE" to elevate the moldboard to its extreme raised position, and thus free the carrying hooks of its weight.

*s.* Pull the hand-control shaft (fig. 31) downward to disengage the carrying hooks; then move it upward to again engage them. Do this several times to check operation of the entire carrying-hooks mechanism. Adjust any interference or lost motion that is discovered.

*t.* Lower the moldboard to the ground and turn off the vehicle engine (TM 9-759).

*u.* Place the two decalcomanias "CARRYING HOOKS DOWN" and "CARRYING HOOKS UP" on the inside of the differential-carrier housing in front of the driver (fig. 31), to indicate these respective hand-control shaft positions.

*Note.* The "DOWN" decalcomania is above the "UP" decalcomania. To apply each decalcomania: Brush or wipe a light coating of water-resisting clear spar varnish, or clear spraying lacquer over the surface to which the decalcomania is to be applied. Dip the decalcomania in water until the surface will separate freely from the backing. Press the decalcomania onto the surface at the desired mounting position, and slide the backing paper off. Rub the face of the decalcomania with the backing paper, using a light even pressure, to remove all air bubbles. Clean around the edges with volatile-mineral-spirits paint thinner.

### **33. Test Operation of Emergency-Lift Components**

*a.* Start the vehicle engine (TM 9-759) and lower the moldboard to its extreme low position. Remove the oil-reservoir filler plug (fig. 30) from the hand-operated pump oil reservoir and fill the

reservoir with hydraulic oil (OH). Total capacity is approximately 1 gallon. Replace plug tightly.

b. Move the control-valve operating lever to "FLOAT" and lock it in place (par. 43).

c. Raise the release-valve lever (fig. 30) to upright position.

d. Move the hand-operated pump operating lever steadily back and forth to pump oil into the emergency-lift jack and raise the moldboard. Raise the moldboard as high as it will go.

e. Operate the hand-control shaft (fig. 31) to engage the carrying hooks with their pins. If the emergency-lift jack has elevated the moldboard properly, these will readily engage.

*Note.* Failure of hooks to engage will indicate too much slack in the emergency-lift cable, with consequent failure of mechanism to elevate moldboard all the way to its extreme raised position. Readjust the cable as explained in paragraph 29 s through u.

f. Disengage the carrying hooks and move the release-valve lever (fig. 30) down (lever rotates downward toward rear of the vehicle). The moldboard should now slowly settle to the ground as oil is forced (by its weight) out of the emergency-lift jack back into the hand-operated pump oil reservoir.

g. Operate the control-valve operating lever to again drive the moldboard to its extreme lowered position, and recheck the level of oil in the hand-operated pump oil reservoir. Add oil (*a* above) as required to bring the level up to the bottom of the filler plug.

**Caution:** Never add oil to this reservoir unless the moldboard is in the extreme lowered position, thus placing the piston of the emergency-lift jack full up in the cylinder. If reservoir should be filled while the piston is partially out of its cylinder, there would be too much oil locked into this closed hydraulic system, and it would be impossible to lower the moldboard to its extreme low position without damage to the mechanism.

h. Move the control-valve operating lever to "FLOAT," and turn off the vehicle engine (TM 9-759).

## 34. Replacement of Vehicle Parts on Interior

a. Install the universal-joint cover.

b. Install all floor plates on the left side of the interior.

c. Install all of the sloping ammunition-stowage racks on the left side of the interior.

d. If the turret was removed from the vehicle, install the turret and gun.

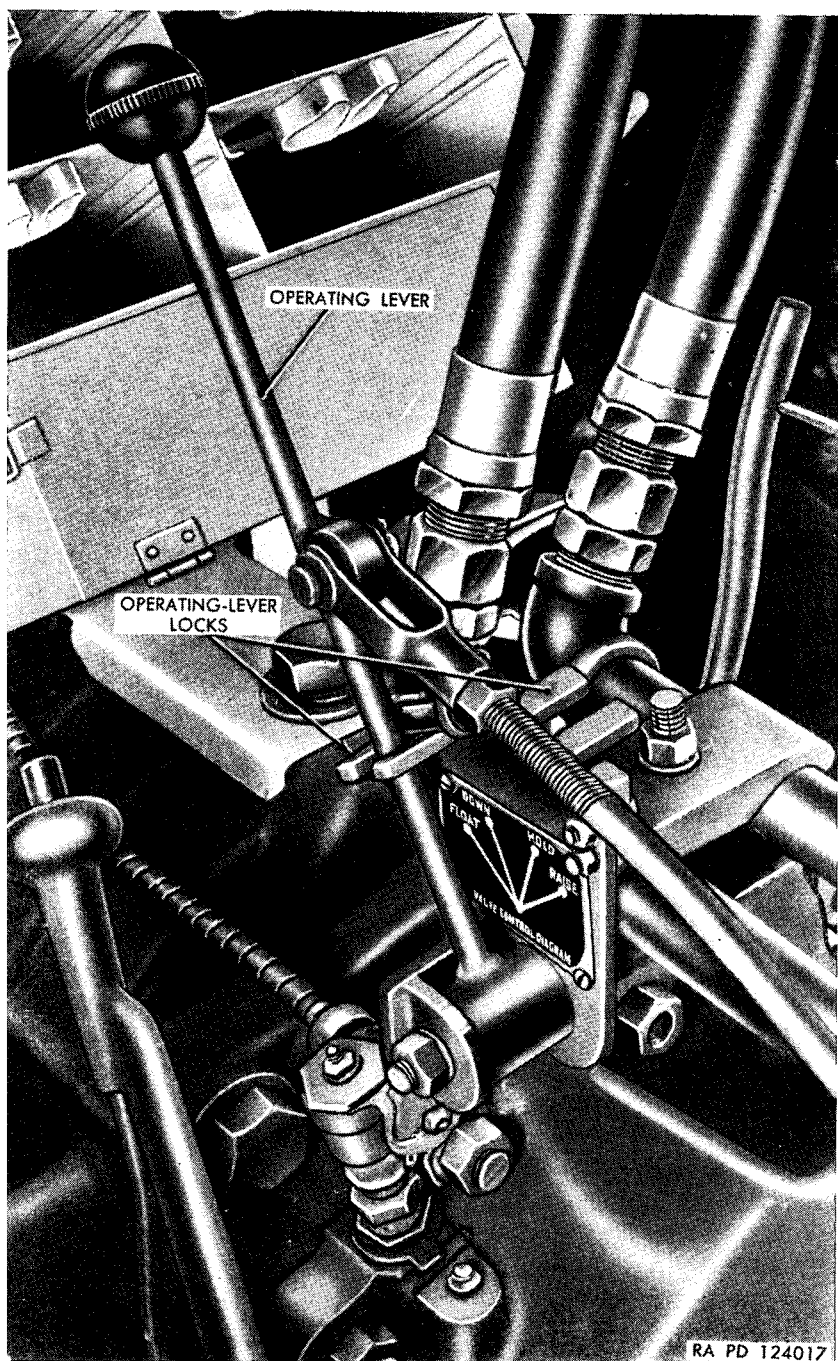
## Section II. CONTROLS AND OPERATION

### 35. General

This section describes, locates, illustrates, and furnishes the driver of the vehicle with sufficient information pertaining to the various controls and instruments provided for the proper operation of the equipment; and also contains instructions for the mechanical steps necessary to the operation of the equipment under usual conditions.

### 36. Control-Valve Operating Lever

The power-driven hydraulic system is operated by means of the control-valve operating lever, which is a vertically disposed lever located on top of the vehicle transmission housing at the driver's right (fig. 32). This lever is connected by a control rod to the control-rod to valve-stem head link on the hydraulic-pump control valve (fig. 20). An instruction plate (fig. 32) secured to the left side of the operating-lever shaft supporting bracket, indicates the four positions of lever operation. These positions are, reading from front to rear: "FLOAT," "DOWN," "HOLD," and "RAISE." Placing the lever in either the "DOWN" or "RAISE" position will result in corresponding movement of the moldboard, which will continue to be lowered or raised so long as the lever remains at the position indicated, or until the moldboard has reached the extremity of its travel in the direction indicated. Placing the lever at "HOLD" will result in maintaining the moldboard fixed at whatever position it is in at the moment. When the lever is moved to "FLOAT," the moldboard can be freely moved by external force, either up or down and, if raised above the ground at the time the lever is placed in this position, will slowly settle to the ground by reason of its own weight.



*Figure 32. Control-valve operating-lever locks.*

### **37. Operating Lever Locks**

Locks (fig. 32) are provided to secure the control-valve-operating lever at either of two of the positions ("FLOAT" or "HOLD") indicated on the instruction plate. These yoke-type locks are pivot mounted on the operating-lever shaft supporting bracket, at the right side of the operating lever. Each can be rotated to the left to engage the lever, whenever the lever is positioned in alignment with the lock.

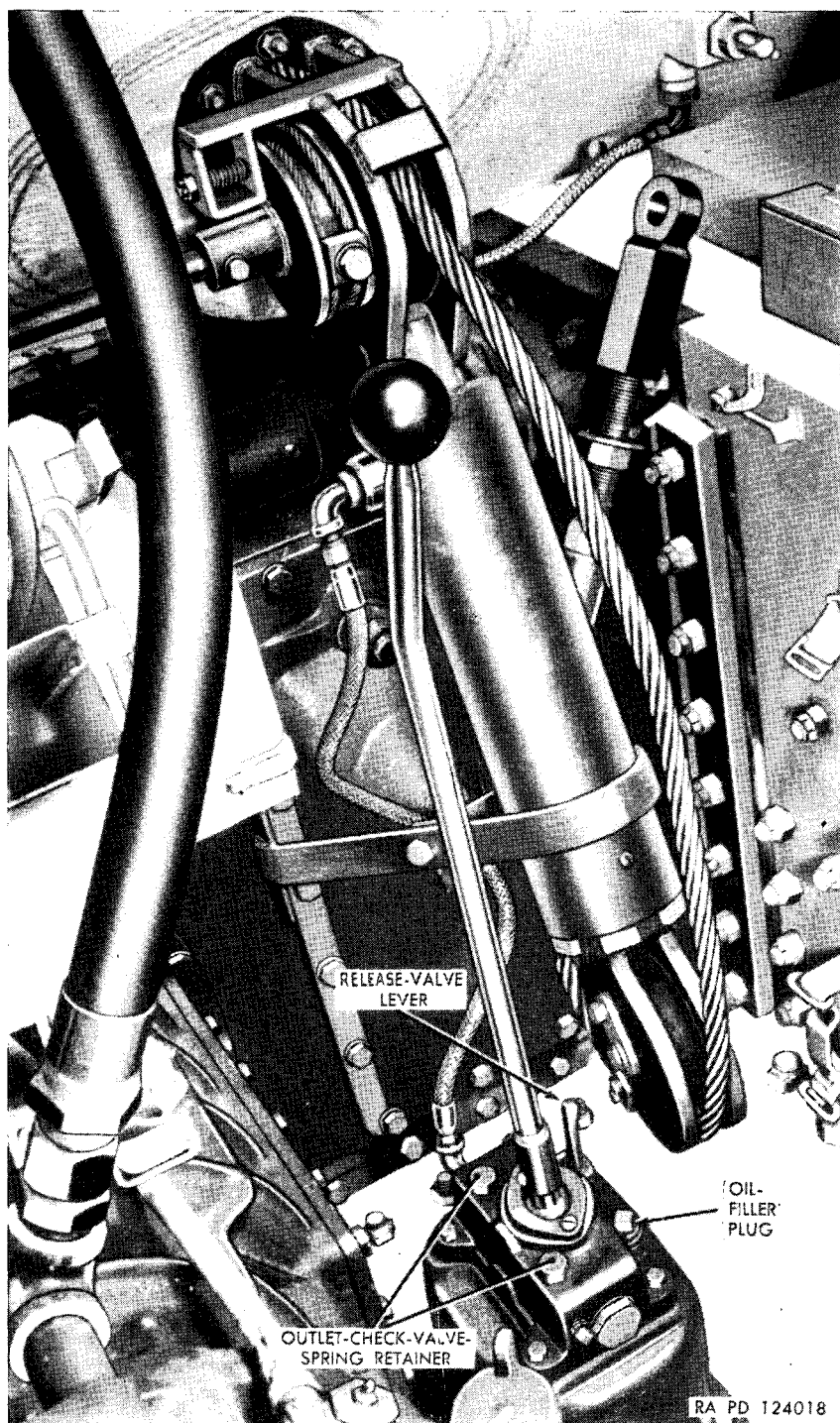
### **38. Hand-Control Shaft Lever**

Carrying hooks (fig. 27) are provided to maintain the moldboard at its extreme elevated position, for travel use. The engagement and disengagement of these hooks is controlled by the hand-control shaft. This shaft holds a lever (fig. 31) that is positioned just behind the differential-carrier housing inner wall, approximately in front of the driver's right hand. When the lever is moved to an upright position, the carrying hooks are lowered to engage and secure the moldboard. Rotating the lever backwards and down will disengage the carrying hooks. Decalcomanias affixed to the differential-carrier housing inner wall, adjacent to the lever, provide correct instructions for the driver regarding these two lever positions. One decalcomania reads "CARRYING HOOKS DOWN;" the other reads "CARRYING HOOKS UP."

*Note.* Engagement or disengagement of the carrying hooks cannot be effected (because of the weight of the moldboard) unless the control-valve operating lever is first placed at "RAISE," to lift the weight of the moldboard from the hooks.

### **39. Emergency-Lift Pump Operating Lever**

Emergency-lift operation of the moldboard to a carrying position is provided by a hand-operated emergency-lift pump (fig. 33). This pump is operated by means of the hand-operated pump operating lever located on top of the pump. The position of the pump places this handle approximately in front of the assistant driver's left hand. The lever is operated by a backward and forward motion. Operation of the lever pumps hydraulic oil into the emergency-lift jack to slowly extend the ram of this jack and thus exert a lift on the emergency-lift cable, to raise the moldboard. Full extension of the jack ram will raise the moldboard to its extreme elevated position so that the carrying hooks can be engaged.



*Figure 33. Emergency-lift hand-operated pump controls.*

## **40. Release-Valve Lever**

Operation of the emergency-lift pump is controlled by the release-valve lever. This lever (fig. 33) is on top of the emergency-lift pump, just to the right of the pump operating handle. When the lever is placed in an upright position, the hydraulic system between the emergency-lift pump and the emergency-lift jack becomes a closed hydraulic system, and operation of the pump operating lever will result in pumping of hydraulic oil into the jack for elevation of the moldboard. When the lever is rotated backwards and down to a horizontal position, the hydraulic system is opened to the reservoir below the pump. Any hydraulic oil which is in the jack cylinder will now be expelled from the cylinder, back into the reservoir, by the force exerted on the jack ram by the weight of the moldboard. Placing the lever in the horizontal position, whenever the moldboard is elevated and the carrying hooks are not engaged, will therefore result in allowing the moldboard to slowly settle back to the ground.

## **41. Before Operation Service**

Open the drain cock to check oil level in the hydraulic-oil reservoir and add hydraulic oil, if required, as instructed in paragraph 21. Remove the breather plug from the hand-operated pump oil reservoir to check the level of oil in the reservoir and add hydraulic oil, if necessary, as instructed in paragraph 33.

## **42. Operation of Vehicle With Bulldozer Attached**

With the bulldozer attached, operate the vehicle in low gear and in the same manner used for normal operation of the vehicle alone (TM 9-759). Note, however, that the turning radius required will be greatly increased whenever the bulldozer moldboard is in digging position. When first operating the vehicle with the bulldozer attached, raise and lower the moldboard several times to become thoroughly familiar with the operation of the controls, prior to actual moving of earth or obstacles. Always have the vehicle moving slowly in low gear, before lowering the moldboard to digging position. Lower the moldboard gradually until the desired depth has been reached. With the vehicle moving forward at a steady speed, raise or lower the moldboard, as required, to compensate for uneven ground.

## **43. Operation of Power-Driven Hydraulic System**

*a.* Whenever the vehicle engine is in operation, the hydraulic pump of the bulldozer drive will likewise be in operation, and movement of

the moldboard will be subject only to the positioning of the control-valve operating lever.

b. As the moldboard should always be carried, when not in use, with the carrying hooks engaged, the first operation necessary is that of disengaging the carrying hooks. To accomplish this, place the control-valve operating lever at "RAISE" and hold it in this position while moving the hand-control shaft to the "CARRYING HOOKS UP" position.

c. If it is not desired to lower the moldboard immediately, next place the operating lever at "HOLD." The lever can be locked in this position, and the moldboard will remain in its last position.

d. To lower the moldboard, move the operating lever to "DOWN"—the moldboard will be continuously lowered, as long as the lever remains in this position, until it reaches the lowest point of its travel. If the lever is allowed to remain at "DOWN" after the moldboard is fully lowered, operation of the hydraulic system will keep the moldboard in this position without damage to the system; but, if the moldboard is to be maintained at this position for any length of time, it is advisable to move the lever back to "HOLD" and lock it there.

e. When the lever is moved to "RAISE," the moldboard will be steadily elevated until it reaches the uppermost point of its travel.

f. The "FLOAT" position is not used during ordinary operation of the bulldozer. It is used for emergency operation (par. 44).

g. On completion of bulldozer operation, move the operating lever to "RAISE" to elevate the moldboard to its uppermost position, and hold the lever in this position while moving the hand-control shaft to the "CARRYING HOOKS DOWN" position. After carrying hooks have been engaged, the operating lever can be moved back to "HOLD" and locked in this position, and the vehicle can be operated without further concern for the bulldozer controls.

#### **44. Operation of Hand-Operated (Emergency-Lift) Hydraulic System**

The hand-operated emergency-lift pump is provided for use only when it is desired to raise the moldboard to carrying position, and the power-driven hydraulic system is malfunctioning. To use the emergency-lift pump, first place the control-valve operating lever at "FLOAT" and lock it in this position. When the release-valve lever has been closed (by placing the lever in an upright position) subsequent pumping of the pump operating lever back and forth will result in raising of the moldboard. Continue operation of the pump until the



moldboard is fully elevated; then move the hand-control shaft to the "CARRYING HOOKS DOWN" position.

*Note.* Ordinarily, the moldboard will not again be lowered until the bulldozer drive is functioning properly, and will therefore not be lowered by operation of the emergency-lift pump. Should this be required, however, it will be necessary to operate the pump to again raise the moldboard to its extreme elevated position (it will probably be settled onto the carrying hooks), before the carrying hooks can be disengaged. After disengaging the carrying hooks, open the release-valve (lever horizontal) to let the moldboard down.

**Caution:** Whenever the moldboard has been elevated by the emergency-lift pump and the carrying hooks have been engaged, always complete this operation by rotating the release-valve lever backward and down to the open position. This will prevent any subsequent accidental operation of the power-driven hydraulic system while the valve is still closed (and hydraulic oil is trapped in the emergency-lift jack). Movement of the moldboard under such a condition (against the holding pressure of the emergency-lift jack) would damage the equipment. Whenever the moldboard is elevated with the carrying hooks engaged and the vehicle engine in operation, and it is necessary to move the control-valve operating lever into the "FLOAT" position, always move the lever as rapidly as possible past the "DOWN" position, as any delay in the "DOWN" position would result in putting undue strain on the carrying hooks.

## 45. Operating Precautions

a. When making a level cut, do not lower the moldboard to such an extent that it will stall the vehicle engine. Take only the depth cut that can be handled without slowing the speed of the engine too much.

b. Watch the up-and-down motion of the front of the vehicle and compensate for this motion by lowering or raising the moldboard. When the front of the vehicle starts to "nose up," lower the moldboard; when the front of the vehicle starts to "nose down," raise the moldboard; but only far enough to compensate for the vehicle motion.

c. When cutting very hard material and the engine becomes overloaded, raise the moldboard until the load on the engine is eased.

d. When the moldboard is full of material, lift it slightly before trying to turn the vehicle.

e. When on steep inclines, keep the vehicle in first or second gear, with the master clutch engaged. Use compression of vehicle engine to hold down the speed.

f. Never engage the vehicle clutch part way while using the bulldozer.

g. Always return the vehicle steering levers to full release position immediately after using them.

## **CHAPTER 3**

### **ORGANIZATIONAL MAINTENANCE INSTRUCTIONS**

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#### **Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR ORGANIZATIONAL MAINTENANCE**

##### **46. General**

Tools and equipment are issued to the using organization for maintaining the matériel. Tools and equipment should not be used for purposes other than prescribed, and when not in use, should be properly stored in the chest and/or roll provided for them. Spare parts are supplied to the using organization for replacement of those parts most likely to become worn, broken, or otherwise unserviceable, when such operations are within the scope of organizational maintenance functions. Spare parts, tools, and equipment supplied for the tank-mounting bulldozer M2 are listed in Department of the Army Supply Catalog ORD 7-8 SNL G-247, which is the authority for requisitioning replacements.

##### **47. Common Tools and Equipment**

Standard and commonly used tools and equipment having general application to this matériel are listed in the catalog, but are not specifically identified in this manual.

##### **48. Special Tools and Equipment**

No specially designed tools and equipment for organizational maintenance, repair, and general use with the tank-mounting bulldozer M2 are required.

#### **Section II. LUBRICATION AND PAINTING**

##### **49. Lubrication Order**

Lubrication order shown in figure 34 describes organizational lubrication maintenance. This order prescribes cleaning and lubrication

procedures as to locations, intervals, and proper materials for this equipment. Lubrication Order LO 9-722 is issued with each bulldozer and is to be carried with the vehicle on which the bulldozer is mounted at all times. In the event that a bulldozer is received without this lubrication order, the using organization shall immediately requisition one. (See SR 310-20-4.)

*Note.* Lubrication Order LO 9-722 will be printed as a decalcomania and is to be installed on the inner wall of the vehicle hull, above and to the left of the steering levers in the driver's compartment.

<b>LUBRICATION ORDER</b>		<b>LO 9-722</b>
<b>BULLDOZER, TANK MOUNTING, M2</b>		
References: TM 9-722, ORD 7-8 SNL G-247		
Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be adjusted to compensate.		
A, fig 35 →	<b>OIL RESERVOIR FILL and LEVEL</b> — Check level daily, before operation, with moldboard in lowered position. Fill to level with OHA. <b>CAUTION: Do not over fill.</b>  <b>OIL RESERVOIR DRAIN</b> — Drain every 300 hours. Drain only after operation. Flush system with TPM or SD. Refill to level. Operate moldboard up and down a few times and recheck level. (Approximate capacity 16 gallons)	
B, fig 35 →	<b>EMERGENCY LIFT HOIST FILL and LEVEL</b> — Check level daily, before operation, with moldboard in raised position. Fill to level with OHA.  <b>EMERGENCY LIFT HOIST DRAIN</b> — Drain once a year. Flush system with TPM or SD. Refill to level. Operate hand pump to raise and lower moldboard and recheck level. (Approximate capacity 1 gallon)	
C, fig 35 →	<b>HYDRAULIC PUMP DRIVE</b> — Daily, before operation, add OE 30 above 0° F., OE 10 below 0° F., through filler pipe to overflow of oil level cup.	
D, fig 35 →	<b>EMERGENCY LIFT CABLES</b> — Monthly, clean emergency lift cables with TPM or SD and coat with CT.	
E, fig 35 →	<b>OIL CAN POINTS</b> — Daily, lubricate all control linkage, clevises and pins with PL (Med) above +32° F., PL (Special) below +32° F.  <b>DO NOT LUBRICATE</b> — Exterior pivots, trunnions and cable sheave pins.	
<b>— LUBRICANTS —</b>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> OE — OIL, engine  PL — OIL, lubricating, preservative  OHA — OIL, hydraulic, petroleum base </div> <div style="width: 45%;"> CT — COMPOUND, rust preventive thin film  SD — SOLVENT, dry cleaning  TPM — THINNER, paint, volatile mineral spirits </div> </div>		

RA PD 124019

*Figure 34. Lubrication order.*

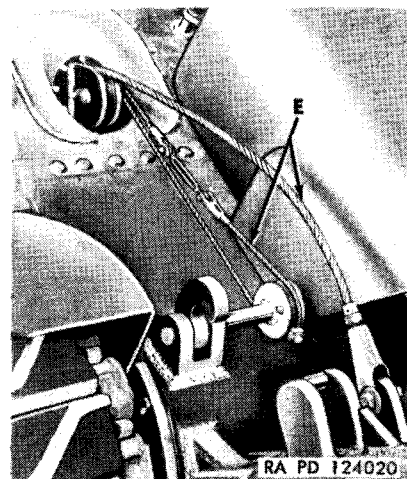
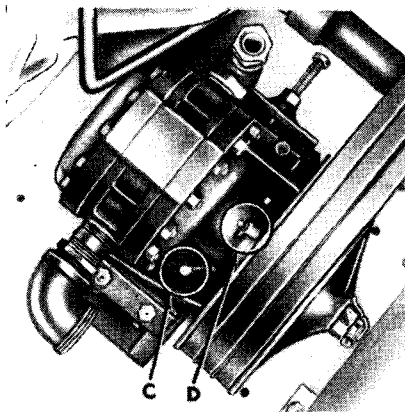
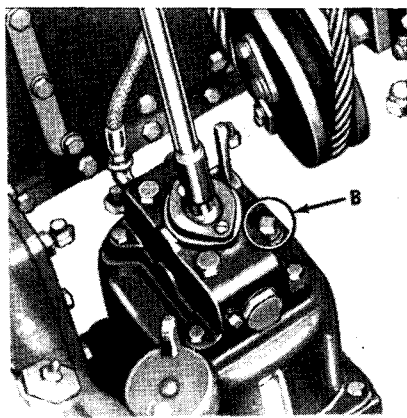
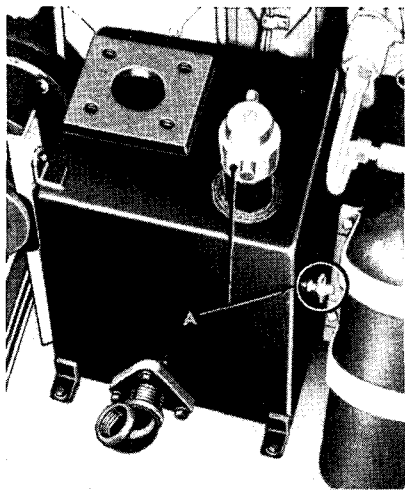
## 50. Lubrication Instructions

*a.* **USUAL CONDITIONS.** Service intervals specified on the lubrication order are for normal operation and under conditions in which moderate temperature, humidity, and atmospheric conditions prevail.

b. **LUBRICATION EQUIPMENT.** Each vehicle is supplied with lubrication equipment adequate for maintenance of the bulldozer mounted thereon. This equipment will be cleaned both before and after use. Lubricating guns will be operated carefully, and in such a manner as to insure a proper distribution of the lubricant.

c. **POINTS OF APPLICATION.**

- (1) Lubricating fittings, oilers, and oilholes are shown in figure 35 and are referenced to the lubrication order. Wipe these devices and the handling surfaces clean before lubricant is applied.
- (2) A  $\frac{3}{4}$ -inch red circle should be painted around all lubricating fittings and oilholes.



*Figure 35. Localized lubrication views.*

*d.* **REPORTS AND RECORDS.**

- (1) Report unsatisfactory performances of matériel, or defects in the application or effect of prescribed petroleum fuels, lubricants, and preserving materials, using DA AGO Form 468 (Unsatisfactory Equipment Report).
- (2) Maintain a record of lubrication of the equipment on WD AGO Form 460 (Preventive Maintenance Roster).

*e.* **UNUSUAL CONDITIONS.** Reduce service intervals specified on the lubrication order to compensate for abnormal operation and extreme conditions, such as high or low temperatures, prolonged periods of high-speed operation, continued operation in sand or dust, immersion in water, or exposure to moisture, any one of which may quickly destroy the protective qualities of the lubricant. Intervals may be extended during inactive periods.

*f.* **CHANGING GRADE OF LUBRICANTS.** Lubricants are prescribed and temperature ranges of lubricants, when applicable, are given in the lubrication order instructions. When to change grade of lubricants is determined by maintaining a close check on operation of the equipment during the approach of changeover periods, in accordance with weather forecast data. Sluggish operation is an indication of lubricants thickening, and is the signal to change to grade prescribed for the lower temperature range. Ordinarily, it will be necessary to change grade of lubricants only when air temperatures are consistently in the higher or lower range.

## **51. Painting**

Instructions for the preparation of the matériel for painting, methods of painting, and materials to be used are contained in TM 9-2851.

## **Section III. PREVENTIVE MAINTENANCE SERVICES**

### **52. General**

*a.* **RESPONSIBILITY AND INTERVALS.** Preventive maintenance services are the responsibility of the using organization. These services consist generally of before-operation, during-operation, at-the-halt, after-operation, and weekly services performed by the driver or operator, and the scheduled services to be performed at designated intervals by organization mechanic or maintenance crews. Intervals are based on normal operations. Reduce intervals for abnormal operations or severe conditions. Intervals during inactive periods may be extended accordingly.

b. **DEFINITION OF TERMS.** The general inspection of each item applies also to any supporting member or connection and is generally a check to see whether the item is in good condition, correctly assembled, secure, and not excessively worn.

- (1) The inspection for "good condition" is usually an external visual inspection to determine whether the unit is damaged beyond safe or serviceable limits. The term "good condition" is explained further by the following: not bent or twisted, not chafed or burned, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, not deteriorated.
- (2) The inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to see whether or not it is in its normal assembled position in the vehicle.
- (3) Inspection of a unit to determine if it is "secure" is usually an external visual examination or a wrench, hand-feel, or a pry-bar check for looseness. Such an inspection must include any brackets, lock washers, lock nuts, locking wires, or cotter pins used.
- (4) By "excessively worn" is meant worn beyond serviceable limits, or to a point likely to result in failure if the unit is not replaced before the next scheduled inspection.

## **53. Cleaning**

a. **GENERAL.** Any special cleaning instructions required for specific mechanisms or parts are contained in the pertinent section. General cleaning instructions are as follows:

- (1) Use volatile-mineral spirits paint thinner to clean or wash grease or oil from all parts of the equipment.
- (2) A solution of one part grease-cleaning compound to four parts of volatile-mineral spirits paint thinner or kerosene may be used for dissolving grease and oil from components of the equipment. After cleaning, use cold water to rinse off any solution which remains.
- (3) Use clean water or a soap solution of one-fourth pound of soap chips to a gallon of hot water for all rubber parts, and for overall general cleaning of painted surfaces.
- (4) After the parts are cleaned, rinse and dry them thoroughly. Take care to keep the parts clean.
- (5) Remove the protective-grease coating from new parts, since this grease is usually not a good lubricant.

## b. GENERAL PRECAUTIONS IN CLEANING.

- (1) Volatile-mineral spirits paint thinner is inflammable and should not be used near an open flame. Fire extinguishers should be provided when this material is used. In addition, it evaporates quickly and has a drying effect on the skin. If used without gloves, it may cause cracks in the skin and, in the case of some individuals, a mild irritation or inflammation. Use only in well-ventilated places.
- (2) Avoid getting petroleum products such as volatile-mineral spirits paint thinner, engine fuels, or lubricants on rubber parts, as the petroleum product will deteriorate the rubber.
- (3) The use of gasoline or benzine for cleaning is prohibited.

## 54. Preventive Maintenance by Driver or Operator

a. **PURPOSE.** To insure mechanical efficiency, it is necessary that the equipment be systematically inspected at intervals, each day it is operated and weekly, so defects may be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. Any defects or unsatisfactory operating characteristics beyond the scope of the driver or operator to correct must be reported at the earliest opportunity to the designated individual in authority.

b. **SERVICES.** Table II lists the services to be performed by the driver or operator at the designated intervals, which are before-operation, during-operation, at-the-halt, after-operation, and weekly.

Table II. Operator's preventive-maintenance services

INTERVALS					Procedure
Before operation	During operation	At-the-halt	After operation	Weekly	
X	----	X	X	X	(1) <i>Oil.</i> Check the amount of oil in the hydraulic pump and hand-operated pump reservoirs (pars. 74 and 103). Add oil if necessary.
X	----	X	X	X	(2) <i>Oil leaks, general.</i> Check around the hydraulic pump, hand-operated pump, hydraulic cylinders, control valve, emergency-life jack, and lines, and fittings for any indication of oil leaks.
X	----	X	X	X	(3) <i>Visual inspection of equipment.</i> Inspect the entire equipment for any visible damage that would make the equipment unfit for use. Inspect the mold-board cutting edge to make sure it is securely mounted and is not bent or dulled.

Table II. Operator's preventive-maintenance services—Continued

INTERVALS					Procedure
Before operation	During operation	At-the-halt	After operation	Weekly	
X	X	---	---	X	(4) <i>Controls</i> . With the engine running, operate the power-driven hydraulic system (par. 43) to determine whether or not the controls are in good operating condition. Stop engine and operate the hand-operated (emergency-lift) hydraulic system (par. 44). Adjust controls as necessary (pars. 19 and 29).
	X	---	---		(5) <i>Operating observations</i> . While the equipment is in operation, be alert for any sounds such as rattles, knocks, or squeaks that may be signs of trouble. Note any unusual or unsatisfactory performance. Any unusual noises or unsatisfactory performance should be investigated at the next halt.
			X	---	(6) <i>Clean equipment</i> .
				X	(a) Wipe dirt, oil, and grease off all components of equipment.
				X	(b) Wash all components thoroughly, when possible.
				X	(7) <i>Hydraulic-pump belt set</i> . Inspect the three belts to determine that they are not worn or damaged. Adjust if necessary (par. 18).
X	---	---	---	X	(8) <i>Cables</i> . Carefully examine the emergency-lift and carrying-hooks cables for stretching and for abnormal wear. Adjust cables if necessary (pars. 29 and 32).
X	---	---	---	X	(9) <i>Decalcomanias and instruction plate</i> . Check to see that the two carrying-hooks instruction decalcomanias (par. 38) and the control-valve operating lever instruction plate (par. 36) are in good condition.
				X	(10) <i>Publications</i> . Check to see that TM 9-722, TM 9-759, and ORD 7-8 SNL G-247 are on hand and in good order.
			X	X	(11) <i>Lubrication</i> . Lubricate equipment in accordance with instructions contained in LO 9-722 (par. 49).

## 55. Preventive Maintenance by Organizational Maintenance Mechanics

*a. INTERVALS.* The frequency of the preventive maintenance service prescribed is considered a minimum requirement for normal operation of the bulldozer. Under unusual conditions, such as extreme temperatures, dust or sand, or extremely wet terrain, it may be necessary to perform certain maintenance services more frequently.



b. **OPERATOR PARTICIPATION.** The operator should accompany the bulldozer and assist the mechanics while periodic organizational preventive maintenance services are performed. Ordinarily, the operator should present the bulldozer for a scheduled preventive maintenance service in a reasonably clean condition.

c. **SPECIAL SERVICES.** The special services are as follows:

- (1) *Adjust.* Make all necessary adjustments in accordance with the pertinent section of the manual, technical bulletins, or other current directives.
- (2) *Clean.* Clean the bulldozer as outlined in paragraph 53 to remove old lubricant, dirt, and other foreign material.
- (3) *Special lubrication.* This applies either to lubrication operations that do not appear on the bulldozer lubrication order, or to items that do appear on the order but which should be performed in connection with the maintenance operations if parts have to be disassembled for inspection or service.
- (4) *Serve.* This usually consists of performing special operations, such as draining and refilling units with oil.
- (5) *Tighten.* All tightening operations should be performed with sufficient wrench torque (force on the wrench handle) to tighten the unit according to good mechanical practice. Use a torque-indicating wrench where specified. Do not overtighten, as this may strip threads or cause distortion. Tightening will always be understood to include the correct installation of lock washer, lock nuts, lock wire, or cotter pins provided to secure the tightening.

d. **SPECIAL CONDITIONS.** When conditions make it difficult to perform the complete preventive maintenance procedures at one time, they can sometimes be handled in sections, planning to complete all operations within the week if possible. All available time at halts and in bivouac areas must be utilized, if necessary, to assure that maintenance operations are completed. When limited by the tactical situation, items with special services in the columns should be given first consideration.

e. **PROCEDURES.** Table III lists the services to be performed by the organizational mechanics at the designated intervals. Each page of the table has two columns at its left edge corresponding to quarterly and monthly maintenance respectively.

Table III. Organizational mechanic or maintenance crew preventive maintenance services

INTERVALS		Procedure
Monthly	Quarterly	
		ROAD TEST
X	-----	<i>Power-driven hydraulic system.</i> Operate bulldozer (par. 43). Check for hydraulic-oil leakage at hydraulic pump, control valve, hydraulic cylinders, and at all pipe-and-hose fitting connections.
X	-----	<i>Hand-operated (emergency-lift) hydraulic system.</i> Operate the emergency-lift pump (par. 44). Check for hydraulic-oil leakage at the pump, emergency-lift jack, and in the hydraulic line connecting these two components.
X	-----	<i>Carrying hooks.</i> Operate the hand-control shaft (par. 38) alone and in conjunction with the hand-operated (emergency-lift) hydraulic system (par. 44) to determine whether or not hooks will properly engage and disengage.
		MAINTENANCE OPERATIONS
X	-----	<i>Moldboard, lift link, tilt arms, push beams, and push-beam links.</i> Examine carefully for cracks or distortion.
X	-----	<i>Lift-link brackets, tilt-arm brackets, push-beam brackets, carrying-hooks shaft brackets and cylinder brackets.</i> Examine carefully for cracks or distortion, especially around the welds.
X	X	<i>Pins.</i> Examine pins which attach the moldboard to the push beams and the lift link, the push beams, lift link and tilt arms to the brackets at front of vehicle, and the lift link to the hydraulic-cylinder rams. Check for distortion or wear. Tighten nuts or bolts which secure the pins. Lubricate pins as instructed in the lubrication order (par. 49).
X	X	<i>Carrying-hooks shaft.</i> Examine shaft for distortion. Tighten carrying-hooks set screws, bolts which secure center shaft to right shaft, and screw which secures left shaft to center shaft (fig. 39).
X	X	<i>Hydraulic cylinders.</i> Examine the cylinder rams for distortion or scoring. Lubricate rams as instructed in the lubrication order (par. 49). Tighten the four bolts which secure each cylinder bracket cap to the bracket. Check tightness of eight bolts which secure each cylinder rod-end cover and the two cap screws which secure each cylinder piston-ram oil seal (fig. 59).
X	X	<i>Cables.</i> Examine emergency-lift and carrying-hooks cables for fraying and/or looseness of connections (fig. 39 and 41).
X	X	<i>Control-valve operating lever.</i> Tighten screw that attaches lever to the supporting bracket, the operating-lever lock-support screws, and the bolts which secure the bracket to the vehicle transmission housing (fig. 42).

Table III. Organizational mechanic or maintenance crew preventive maintenance services—Continued

INTERVALS		Procedure
Monthly	Quarterly	
X	-----	<p><i>Hand-operated emergency-lift pump.</i> Check tightness of four cap screws used to mount pump on mounting plates, four cap screws which secure the pump housing to the oil reservoir, the plunger cap, the screw that secures the release-valve lever to the release valve, the two screws that secure the plunger operating-lever packing retainer to the housing, and the two outlet check-valve spring retainers (fig. 55). Inspect the pin that attaches the operating lever to the plunger-operating lever.</p>
	X	<p><i>Emergency-lift jack.</i> Examine the jack plunger for distortion or scoring. Lubricate plunger as instructed in the lubrication order (par. 49). Check tightness of support bracket brace cap screws, the cap screws that secure the cable-connector, jack and sheave pins in the inner and outer sheave supports and the screws that secure the pin in the sheave at the end of the plunger. Check tightness of the eight screws which secure the inner and outer sheave supports together. Examine pins for wear (fig. 41).</p>
	X	<p><i>Hydraulic pump and driven pulley.</i> Examine pulley for cracks or distortion. Tighten four bolts that secure the pump support to the mounting base. Check tightness of castle nut that secures pulley to shaft and the six screws that secure pump to support (fig. 43).</p>
	X	<p><i>Hydraulic-pump drive pulley.</i> Examine pulley for cracks or distortion. Check tightness of eight bolts (par. 16) which secure pulley to the drive-pulley flange, and the eight bolts which secure the flange to the clutch-shaft coupling flange.</p>
	X	<p><i>Hydraulic-pump control valve.</i> Check tightness of four bolts which secure the control valve to the reservoir, the six screws which secure the two covers to the body, and the two bolts which secure the control-rod to valve-stem-head link to the valve-stem head (fig. 54).</p>
	X	<p><i>Hydraulic-oil reservoir.</i> Drain and flush as instructed in the lubrication order (par. 49). Check tightness of four bolts which secure reservoir to floor plates and one bolt which secures the upper right front corner to the support angle (par. 17).</p>
	X	<p><i>Hand-operated emergency-lift pump oil reservoir.</i> Drain and flush as instructed in the lubrication order (par. 49).</p>
FINAL ROAD TEST		
X	-----	<p>Perform final test as outlined under ROAD TEST at beginning of this table. Pay especial attention to any items which have been repaired or adjusted.</p>

## Section IV. TROUBLE SHOOTING

### 56. Scope

a. This section contains troubleshooting information and tests for locating and correcting some of the troubles which may develop in the bulldozer. Trouble shooting is a systematic isolation of defective components by means of an analysis of the bulldozer trouble symptoms; testing to determine the defective components; and applying the remedies. Each symptom of trouble given for an individual unit or system is followed by a list of probable causes of the trouble and suggested procedures to be followed.

b. This manual cannot cover all possible troubles and deficiencies that may occur under the many conditions of operation. If a specific trouble, test, and remedy therefor is not covered herein, proceed to isolate the system in which the trouble occurs and then locate the defective component. Use all the senses to observe and to locate troubles. Question the bulldozer operator to obtain maximum number of observed symptoms. The greater the number of symptoms of troubles that can be evaluated, the easier will be the isolation of the defective system and components thereof.

### 57. Power-Driven Hydraulic System

#### a. CONTROL-VALVE OPERATING LEVER WILL NOT MOVE.

- (1) *Control rod jammed (fig. 21).* Inspect the rod for freedom of movement, particularly at the point of support provided by the control-rod guide bracket. If rod is bent or otherwise damaged, either straighten the rod or install a new rod (par. 19).
- (2) *Control-rod to valve-stem-head link "frozen."* Notify ordnance maintenance personnel.

#### b. MOLDBOARD FAILS TO MOVE.

- (1) *Oil level in hydraulic-oil reservoir too low.* Fill reservoir as required (par. 21).
- (2) *Control rod out of adjustment.* Adjust rod as required (par. 19).
- (3) *Hydraulic-pump belts damaged or loose.* Inspect the three hydraulic-pump belts for damage or excess looseness. Install new belts, as required, and/or adjust belt tension (par. 18).
- (4) *Oil leakage in hydraulic lines.* Inspect all hydraulic lines and connections for leaks. Install new lines and connections (pars. 18, 19, and 20) as required.

*Note.* A leak or break of major proportion can be expected, rather than a small leak, if there is absolutely no movement of the moldboard even if the reservoir has been filled.

- (5) *Oil leakage from hydraulic pump, control valve, or hydraulic cylinders.* Notify ordnance maintenance personnel.
- (6) *Obstructions in hydraulic-oil lines.* Remove all interior and exterior hydraulic-oil lines and connections (figs. 20, 21, and 22), eliminate any obstructions found in these lines, then install the lines (pars. 18, 19, and 20).

*Note.* Obstructions will most likely be found in the line (fig. 20) between the control valve and the outlet side of the hydraulic pump

*c. MOLDBOARD MOVES TOO SLOWLY.*

- (1) *Air in hydraulic-oil lines.* Fill reservoir as required (par. 21).
- (2) *Control rod out of adjustment.* Readjust control rod to make certain that the control-rod to valve-stem-head link is properly positioned when the control-valve operating lever is at "HOLD" (par. 19).
- (3) *Oil leakage in hydraulic lines.* Inspect all hydraulic lines and connections for leaks. Tighten and/or install new lines and connections (pars. 18, 19, and 20) as required.

*Note.* A very small (high pressure) leak will be sufficient to cause erratic movement of the moldboard.

- (4) *Oil leakage from hydraulic pump, control valve, or hydraulic cylinders.* Notify ordnance maintenance personnel.
- (5) *Relief valve in hydraulic-pump control valve opening too soon.* Remove the relief-valve adjusting screw cover cap (DD, fig. 54), which is at the right side of the control valve (fig. 20) and adjust the relief-valve adjusting screw (under the cap) to keep relief valve from opening under too low a pressure (correct setting is 1,000 psi). To raise the valve pressure setting, rotate adjusting screw clockwise. Set valve so that moldboard will raise up to the extreme position of elevation and so that valve will open immediately thereafter. Turn screw  $\frac{1}{4}$  turn at a time, checking bulldozer operation at each new position of adjustment. If adjustment cannot be made, notify ordnance maintenance personnel.

*d. MOLDBOARD SETTLES SLOWLY WHEN CONTROL-VALVE LEVER IS AT HOLD.*

- (1) *Control rod out of adjustment.* Readjust control rod to make certain that the control-rod to valve-stem-head link is properly positioned when the control-valve operating lever is at "HOLD" (par. 19).
- (2) *Oil leakage in hydraulic lines under pressure when moldboard is raised.* Inspect the hydraulic lines and connections between the control valve and the bottom openings of the

two hydraulic cylinders for leaks. Install new lines and connections (pars. 18, 19, and 20) and/or tighten all connections as required.

*Note.* Best method is to start at the bottom ends of the two hydraulic cylinders and trace back the lines connected to these ends of the cylinders as far as the control valve. A very small (high pressure) leak will be sufficient to permit settling of the moldboard.

*e.* MOLDBOARD MOVES IN ONE DIRECTION; BUT FAILS TO MOVE OR MOVES ERRATICALLY IN THE OTHER DIRECTION.

- (1) *Control rod out of adjustment.* Readjust the control rod (par. 19), as required.
- (2) *Hydraulic-pump control valve malfunctioning.* Notify ordnance maintenance personnel.

*f.* MOLDBOARD FAILS TO FLOAT WHEN CONTROL LEVER IS MOVED TO THIS POSITION. If operation of the moldboard at the "RAISE," "HOLD," and "DOWN" lever position is satisfactory, but is not satisfactory at the "FLOAT" position, there is a malfunction in the control valve. Notify ordnance maintenance personnel.

## 58. Moldboard Linkage

*a.* MOLDBOARD FAILS TO RAISE HIGH ENOUGH FOR ENGAGEMENT OF CARRYING HOOKS

- (1) *Linkages clogged with dirt or rocks.* Inspect all mechanical linkages between the moldboard, push beams, lift link, and tilt arms for interference caused by dirt or rocks wedged between the members. Remove any obstructions found.
- (2) *Interference by carrying hooks.* Inspect the two carrying hooks (fig. 26) for looseness on the carrying-hooks shaft which would permit either or both hooks to drop down and interfere with elevation of the moldboard. Each hook is secured to the shaft assembly by a set screw which turns down into a bore in the shaft. Install new screws and/or tighten screws as required, after properly positioning the hooks on the shaft.

*Note.* Proper hook position can be determined by locating the screw bore in the shaft.

- (3) *Lift link, push beams, tilt arms, or push-beam links out of line.* Notify ordnance maintenance personnel.

*b.* MOLDBOARD FAILS TO "DIG IN" PROPERLY.

- (1) *Moldboard cutting edge loose or damaged.* Inspect the moldboard cutting edge for looseness or excessive wear. If

loose, tighten the nuts on the plow bolts which secure the cutting edge to the moldboard. If worn excessively, take out the 21 plow bolts (fig. 36), nuts, and lock washers which secure the edge to the moldboard and remove the cutting edge. Install a new cutting edge.

- (2) *Moldboard or linkages out of line.* Notify ordnance maintenance personnel.

## **59. Hand-Operated (Emergency-Lift) Hydraulic System**

### **a. MOLDBOARD FAILS TO MOVE.**

- (1) *Emergency-lift cable movement obstructed.* Inspect the emergency-lift cable (figs. 27 and 30) for freedom of movement past the three sheaves over which it moves. Remove any obstructions to cable movement.
- (2) *Oil level in hand-operated-pump oil reservoir too low.* Fill reservoir as required (par. 33).
- (3) *Oil leakage in hydraulic line between emergency-lift pump and jack.* Install a new hose and connections, and/or tighten connections as required (par. 31).
- (4) *Obstruction in hydraulic line between emergency-lift pump and jack.* Remove the hose and connections, eliminate any obstructions inside these parts, and install the hose and connections (par. 31).
- (5) *Oil leakage from the emergency-lift pump.* Install a new pump (par. 31).
- (6) *Emergency-lift jack leaking or damaged so that ram will not extend.* Notify ordnance maintenance personnel.
- (7) *Emergency-lift cable or cable sheaves damaged.* Notify ordnance maintenance personnel.

### **b. MOLDBOARD FAILS TO RAISE UP HIGH ENOUGH FOR ENGAGEMENT OF THE CARRYING HOOKS.**

- (1) *Emergency-lift cable stretched.* Readjust cable length (par. 29).
- (2) *Emergency-lift cable loose or damaged.* If cable has loosened at either end, or is damaged, notify ordnance maintenance personnel.
- (3) *Oil trapped in upper part of emergency-lift jack.* Remove the bleeder screw (fig. 58), which is near the upper end of the emergency-lift jack. Now, operate the emergency-lift pump to raise the moldboard all the way up and expell any oil that has seeped past the jack piston and become trapped in the upper portion of the cylinder tube. While moldboard is fully raised, install the bleeder screw.

## 60. Carrying Hooks

### a. CARRYING HOOKS FAIL TO ENGAGE PROPERLY.

- (1) *Carrying hooks loose on shaft.* Inspect the two carrying hooks for security of attachment to the carrying-hooks shaft. These hooks are secured by screws which turn down into bores in the shaft (fig. 40). Relocate the positions of the carrying hooks, if necessary, and securely tighten the screws.
- (2) *Carrying-hooks cable movement impeded.* Check the carrying-hooks cable for binding at the two sheaves over which this cable passes (fig. 27). Remove any obstructions to cable movement.
- (3) *Carrying-hooks cable slipping on drums.* Inspect the carrying-hooks cable-drum block on the drum body (fig. 30) and also the block on the cable drum (fig. 27) to make certain that both blocks are securely mounted to keep the cable from slipping. Tighten the screws which secure these blocks, if necessary (par. 32).
- (4) *Hand-control shaft loose.* Inspect the hand-control shaft (fig. 30) for security of attachment to the cable drum. Install a new cap screw and lock washer, if necessary, to make the hand-control shaft secure in the drum.
- (5) *Carrying-hooks cable stretched.* Readjust cable length if necessary (par. 32).
- (6) *Mechanical linkages bent or damaged.* Inspect the carrying-hooks shaft assembly for distortion or other damage, and also inspect the sheaves over which the carrying-hooks cable passes. If any parts are damaged, notify ordnance maintenance personnel.

b. CARRYING HOOKS FAIL TO DISENGAGE PROPERLY. Moldboard fails to raise up high enough. If the carrying hooks can be engaged, but cannot be easily disengaged, probable cause is failure of the moldboard to raise up high enough (par. 58).

c. FAILURE OF EITHER CARRYING HOOK TO ENGAGE OR DISENGAGE PROPERLY. Hook loose on shaft (fig. 40). Position the hook on the shaft to correspond with the position of the hook which is working properly, then tighten the screw until it seats securely in the bore in the shaft.



## Section V. REMOVAL AND INSTALLATION OF BULLDOZER COMPONENTS

### 61. Moldboard Cutting Edge

*a. REMOVAL.* Raise moldboard (par. 43), so that cutting edge does not contact the ground. Remove 21 plow bolts, lock washers, and nuts (fig. 36) which attach the cutting edge to the moldboard and lift the cutting edge from the moldboard.

*b. INSTALLATION.* Raise the moldboard from the ground (par. 43). Place the moldboard cutting edge (fig. 36) against the bottom front edge of the moldboard and secure it with 21 plow bolts, lock washers, and nuts.

### 62. Moldboard

*a. REMOVAL.*

- (1) Raise the moldboard so that it rests on the bottom edge (par. 43), but stands straight up (fig. 25).
- (2) Remove the split cotter pins, slotted nuts, and two pins which connect the moldboard to one of the push beams. (One of these four short pins is shown in fig. 36.)
- (3) Similarly, remove the two pins connecting the moldboard to the other push beam. This will free the bottom edge of the moldboard.
- (4) Move the operating lever to "DOWN" position (par. 43), until the top edge of the moldboard moves forward and rests against any heavy object.

*Note.* Use the heavy object to support the moldboard in this position.

- (5) Move the operating lever to "FLOAT" position (par. 43).
- (6) Remove the split cotter pin, slotted nut, and pin which connect the moldboard to one of the tilt arms. (One of these two long pins is shown in fig. 36.)
- (7) Similarly, disconnect the moldboard from the other tilt arm.
- (8) Move the operating lever to "RAISE" position (par. 43), to free the tilt arms from the moldboard.
- (9) Remove the moldboard from its position against the supporting object.

*b. INSTALLATION.*

- (1) Position the moldboard in front of the vehicle with the bottom edge resting on the ground (fig. 25).
- (2) Block up the front ends of the two push beams to obtain approximate alinement between the pin holes in the push

B → 9  
C → 10

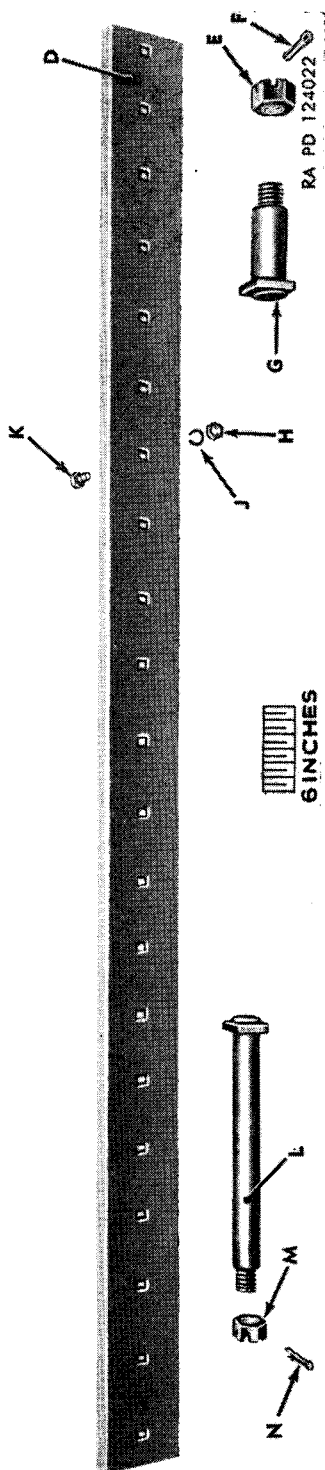
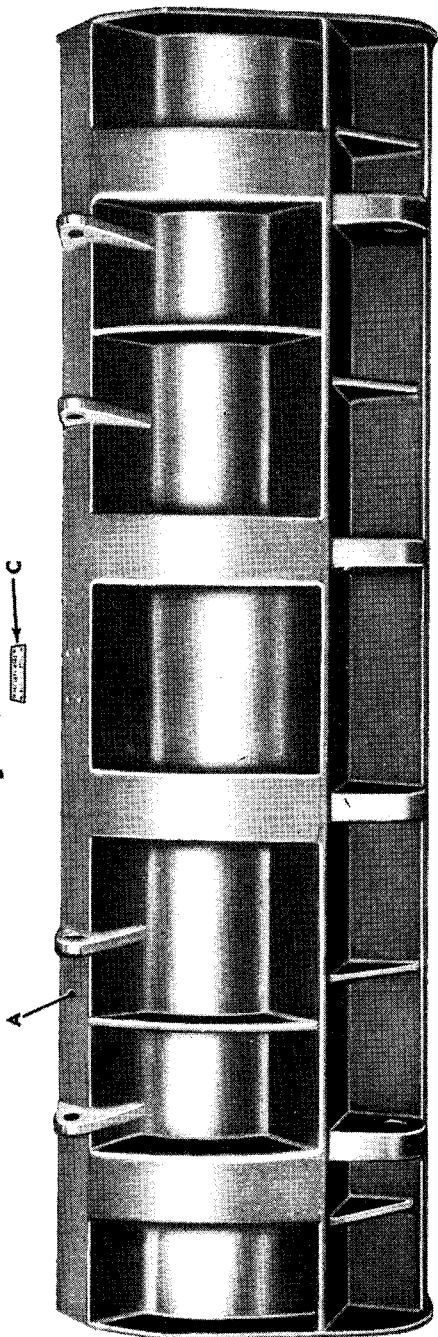


Figure 36. Moldboard and cutting edge—exploded view.

A—MOLDBOARD—7323736  
 B—SCREW, NO. 10 (0.190)—24NC-2 x  $\frac{1}{2}$ —171469  
 C—PLATE, NAME—7323897  
 D—EDGE, CUTTING—7323738  
 E—NUT— $1\frac{1}{4}$ —10NC-3—175080  
 F—PIN— $\frac{3}{8}$  x  $3\frac{1}{8}$ —119197  
 G—PIN— $8\frac{1}{4}$  x  $2\frac{1}{2}$ —7323808  
 H—NUT— $\frac{3}{4}$ —10NC-2—220086  
 J—WASHER, LOCK— $\frac{3}{4}$ -INCH—131046  
 K—BOLT, PLOW— $\frac{3}{4}$ —10NC-2 x  $2\frac{3}{4}$ —218188  
 L—PIN— $20\frac{5}{8}$  x 2—7323654  
 M—NUT— $1\frac{1}{2}$ —12NF-3—122901  
 N—PIN— $\frac{3}{8}$  x  $2\frac{1}{2}$ —119198

beams and the pin holes in the brackets at the bottom rear edge of the moldboard.

- (3) Jockey the moldboard toward the vehicle (to aline the bracket holes with the holes at the ends of the two push beams) and install the four pins which connect the two push beams to the moldboard. Insert each pin from the inside of the push beam toward the outside, and secure it with slotted nut and new split cotter pin. (One of these four short pins is shown in fig. 36.)
- (4) Roll the top of the moldboard back and, at the same time, elevate the forward ends of the two tilt arms to aline the pin holes of the tilt arms with the pin holes in the brackets at the top rear side of the moldboard.
- (5) Install the two long pins which connect the respective tilt arms to the moldboard. Insert each pin from the inside toward the outside, and secure it with a slotted nut and new split cotter pin. (One of these two long pins is shown in fig. 36.)

## 63. Moldboard Linkage

### a. TILT ARMS.

- (1) *Removal.* Remove moldboard (par. 62a). Remove each tilt arm (fig. 25) separately by removing the split cotter pin, slotted nut, and short pin which connect the arm to the tilt-arm bracket on the front of the vehicle. (One of the two short pins which fasten each tilt arm to its bracket is shown in fig. 37.)

*Note.* The emergency-lift cable is secured to the boss on top of the right tilt arm and must be disconnected (par. 68) before removal of this tilt arm.

- A — BEAM, PUSH, LEFT — 7323810  
 B — BEAM, PUSH, RIGHT — 7323809  
 C — SCREW —  $\frac{5}{8}$ -18NF-2 X  $1\frac{1}{2}$  — 215998  
 D — WASHER, LOCK —  $\frac{5}{8}$ -IN — 121574  
 E — PIN —  $7\frac{1}{2}$  X  $2\frac{1}{2}$  — 7524569  
 F — LINK, LIFT — 7323751  
 G — LINK, PUSH-BEAM — 7323764  
 H — PIN —  $8\frac{1}{8}$  X 2 — 7323741  
 J — PIN —  $10\frac{1}{4}$  X 2 — 7323818  
 K — PIN —  $\frac{3}{8}$  X  $3\frac{1}{2}$  — 119197  
 L — NUT —  $1\frac{1}{2}$ -12NF-3 — 122904  
 M — PIN —  $7\frac{1}{2}$  X  $2\frac{1}{2}$  — 7705157  
 N — SCREW —  $\frac{5}{8}$ -18NF-2 X  $1\frac{1}{2}$  — 215998  
 P — ARM, TILT, RIGHT — 7705154  
 Q — ARM, TILT, LEFT — 7705153

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6 INCHES

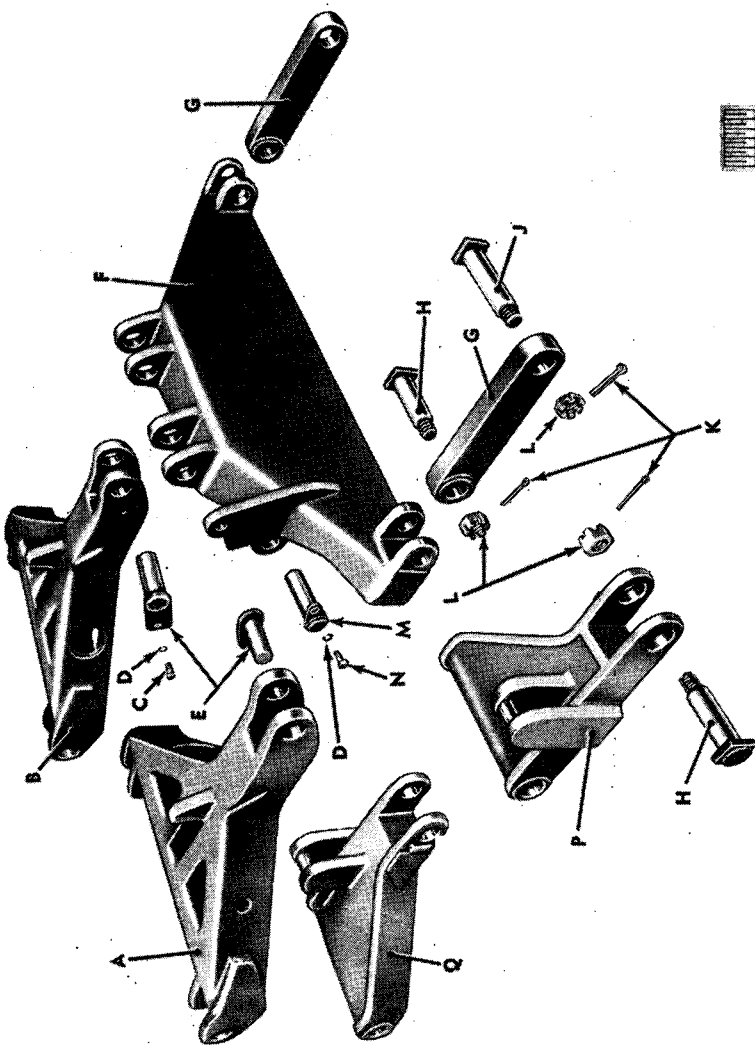


Figure 37. Lift link, push beams, tilt arms, and push-beam links.

- (2) *Installation.* Connect each tilt arm (fig. 37) to its tilt-arm bracket (at front of vehicle), using a short pin, slotted nut and new split cotter pin. Insert pins from outer side toward inner side.

*Note.* The right tilt arm has an upper-projecting bracket on top at the outer side, when installed; and the bracket on top of the left tilt arm will also be on the outer side.

Install moldboard (par. 62*b*, and fig. 25). Connect emergency-lift cable to boss on top of right tilt arm (par. 68).

**b. PUSH-BEAM LINKS.**

- (1) *Removal.* Move control-valve operating lever to "DOWN" position (par. 43) until push beams rest on ground; then move lever to "HOLD" position. Remove each push-beam link by removing the two split cotter pins, slotted nuts, and pins which connect the respective ends of the link to the lift link and to the associated push beam (fig. 37).

- (2) *Installation.*

*Note.* The ends of the links having built-up bosses around the bores are the ends engaged with the lift link.

Connect link to the two pairs of brackets at the bottom front of the lift link (fig. 25), using a pin, slotted nut, and new split cotter pin for each. Insert pins (one of which is shown in fig. 37) from the outside toward the inside. Move the control-valve operating lever to "DOWN" position (par. 43) to lower the lift link until the lower (free) ends of the two push beam links aline with the pin bores in the respective push beams. Connect each link to its push beam with a short pin inserted through the large diameter opening on the inner side of the push beams and thrust outward (one of these short pins is shown in fig. 37). Secure each pin with a slotted nut (which can be installed by reaching down through the top opening in the push beam) and a new split cotter pin.

**c. LIFT LINKS.**

- (1) *Removal.* Remove push-beam links (*b* above). Remove the two bolts, lock washers, and pins which secure the bottom-rear portion of the lift link to the two lift-link brackets at the front of the vehicle. Block the lift link underneath to keep it from dropping, and remove the two bolts, lock washers, and pins which connect the top of the lift link to the two hydraulic-cylinder piston rams (fig. 23). (One of the four short pins which attach the lift link to the lift-link brackets and the piston rams is shown in fig. 37.)

- (2) *Installation.* Refer to paragraph 23.

*d.* **PUSH BEAMS.**

- (1) *Removal.* Remove moldboard (par. 62*a*) and push-beam links (*b* above). Remove the bolt, lock washers, and pin which connect each push beam to the respective push-beam bracket at the front of the vehicle (fig. 25). (One of the two short pins used to connect push beams to push-beam brackets is shown in fig. 37.)
- (2) *Installation.* Position each push beam on the ground in front of vehicle so that the curved portion at the small end turns up and the small diameter hole in one side of the beam is at the other side of the vehicle. Handling one push beam at a time, raise the small end up to align the bore at this end with the bore of the respective push-beam bracket. Insert the short pin used to connect the beam with its bracket, thrusting this pin from the inside toward the outside. (One of these pins is shown in fig. 37.) Secure the pin with a lock washer and bolt. Install moldboard (par. 62*b*) and push-beam links (*b* above).

## **64. Hydraulic-Piping Guards**

*a.* **REMOVAL.**

*Note.* Upper and center guards can be removed independently of others; to remove lower guard, first remove center guard.

- (1) *Remove upper guard.* Remove three bolts and lock washers (fig. 38) and lift the guard from the vehicle.
- (2) *Remove center guard.* Remove four bolts and lock washers (fig. 38) and lift the guard from the vehicle.
- (3) *Remove lower guard.* Remove bolt, seven washers, and nut (fig. 38) which attach each side of guard to the adjacent cylinder outer bracket. Remove two bolts and lock washers which secure guard to mounting blocks on vehicle, and lift guard from vehicle.

*b.* **INSTALLATION.**

- (1) *Install lower guard.* Raise the guard into place (fig. 27) over the hydraulic cylinders. Secure bosses at top corners of guard to mounting blocks on vehicle with a lock washer and bolt for each (fig. 38). Attach sides of guard to the adjacent cylinder outer brackets using a bolt, lock washer, five plain washers, a lock washer, and nut at each side.

- A — BLOCK, MOUNTING — 7323724  
 B — WASHER, LOCK —  $\frac{3}{4}$ -IN — 131046  
 C — BOLT —  $\frac{3}{4}$ -16NF-2 X 2 — 223825  
 D — GUARD, HYDRAULIC PIPING, LOWER — 7323730  
 E — NUT —  $\frac{3}{4}$ -16NF-3 — 122039  
 F — WASHER, PLAIN —  $\frac{3}{4}$ -IN — 131000  
 G — BOLT —  $\frac{3}{4}$ -16NF-2 X  $4\frac{1}{4}$  — 223834  
 H — GUARD, HYDRAULIC PIPING, UPPER — 7323726  
 J — BLOCK, MOUNTING — 7524651  
 K — GUARD, HYDRAULIC PIPING, CENTER — 7323728

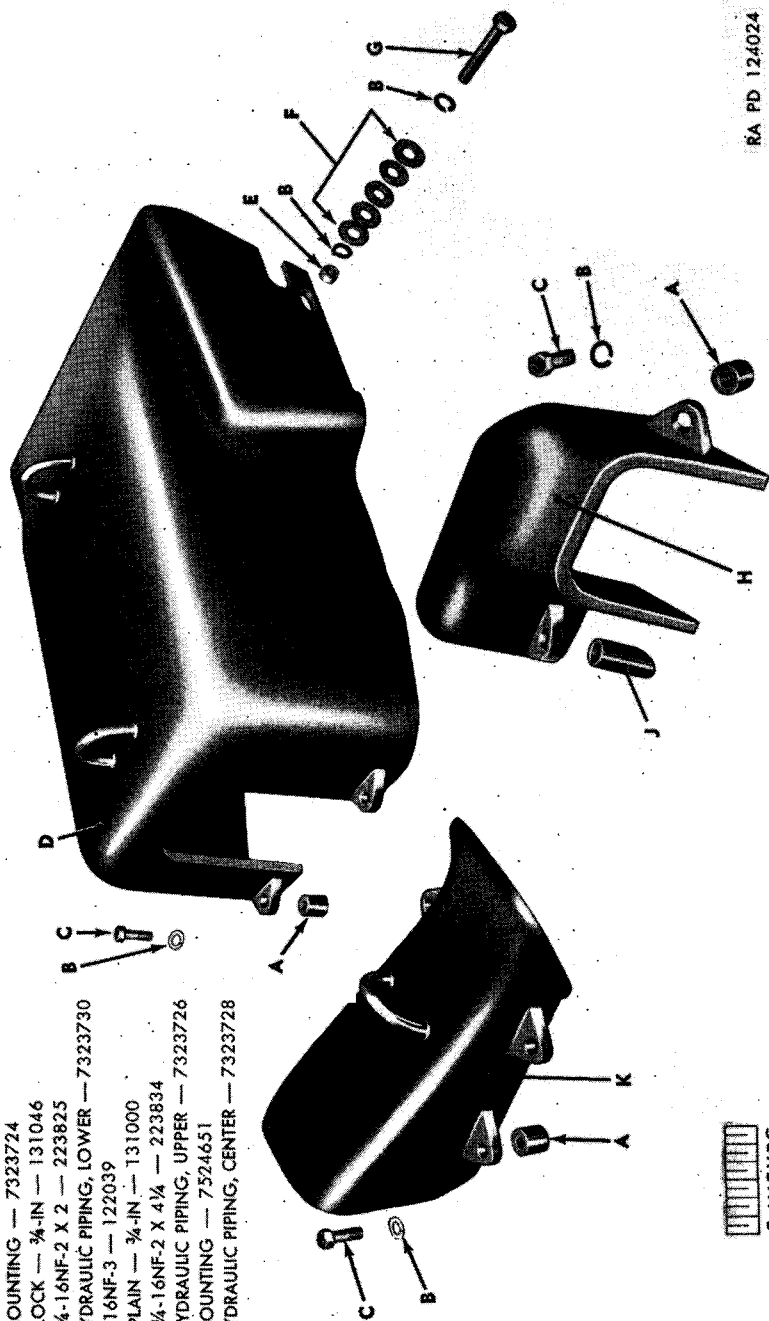


Figure 98. Hydraulic-piping guards.

- (2) *Install centerguard.* Raise the guard into place (fig. 27) and secure it to the four mounting blocks on the vehicle with a lock washer and bolt for each (fig. 38).

*Note.* If lower guard has been removed, it must be installed prior to installation of center guard.

- (3) *Install upper guard.* Raise the guard into place (fig. 27) and secure it to the three mounting blocks on the vehicle with a lock washer and bolt for each (fig. 38).

## **65. Carrying-Hooks Cable**

### **a. REMOVAL.**

- (1) Remove the cap screw, lock washer, and nut (fig. 39) which attach the lower carrying-hooks cable end to the turnbuckle.
- (2) Remove the cap screw, lock washer, and carrying-hooks cable-drum block from the cable-drum body on the carrying-hooks shaft (fig. 27).
- (3) Remove the clevis part of the cable end from the sleeve (fig. 39), extract the pointed plug from the sleeve and pull the sleeve off of the cable.
- (4) Remove the cap screw, lock washer, and drum block from the cable drum inside the vehicle (fig. 30).
- (5) Unwind the cable from the drum on the carrying-hooks shaft, pull this end inside the vehicle and unwind it from the cable drum inside, then pull the end out of the vehicle to free the cable.

**b. INSTALLATION.** Refer to paragraph 32.

## **66. Carrying-Hooks and Shaft**

### **a. REMOVAL.**

- (1) Remove hydraulic-piping lower guard (par. 64).
- (2) Remove the cap screw, lock washer, and nut which attach the lower carrying-hooks cable end to the turnbuckle (fig. 39).
- (3) Remove the cap screw, lock washer, and carrying-hooks cable-drum block from the cable-drum body on the carrying-hooks shaft (fig. 39).
- (4) Loosen the cable to slip it to one side of the drum, then unwind the lower end of the cable from around the shaft.
- (5) Loosen the two set screws (fig. 39) which tighten the carrying hooks onto the shaft.
- (6) Remove the two cap screws, lock washers, and nuts which secure the flange of the center shaft (fig. 39) to the drum body and flange of the right shaft.



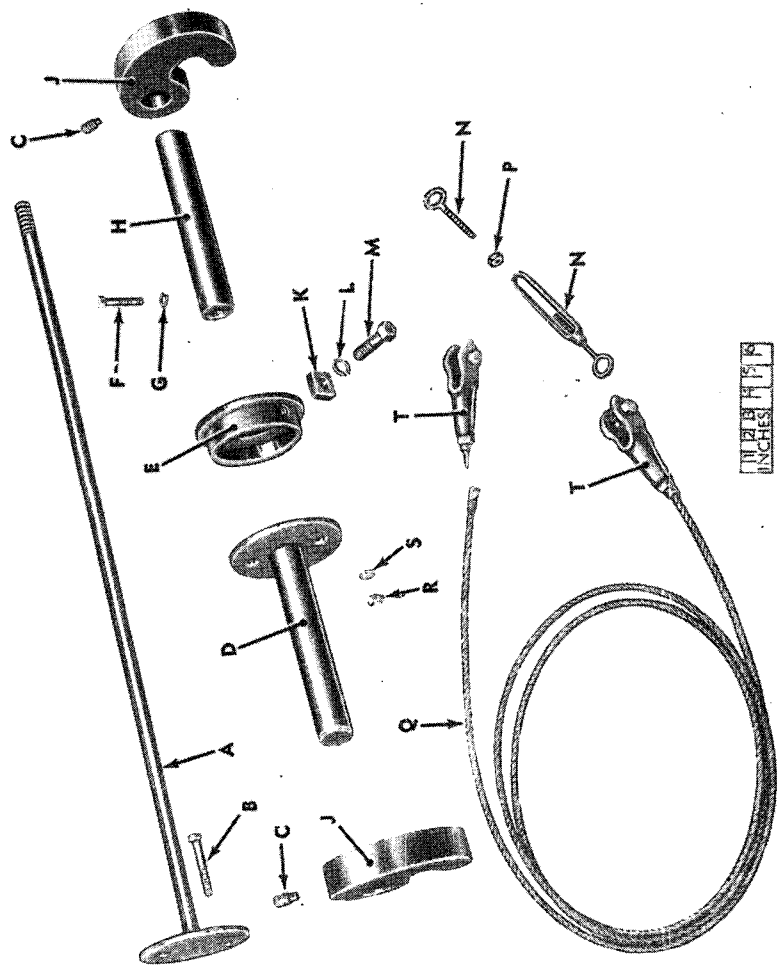


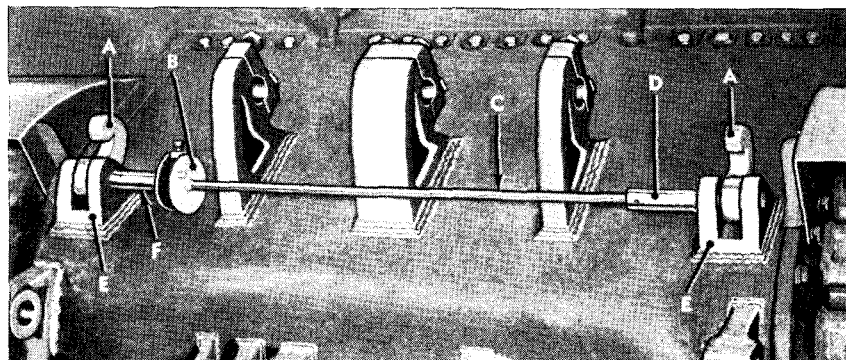
Figure 39. Carrying-hooks shaft and cable.

- (7) Remove the cap screw and lock washer which secure the left shaft to the center shaft (fig. 39), and slide the center shaft into the left shaft as far as possible. This will allow the drum body to fall away from the right shaft.
- (8) Pull the right shaft (fig. 39) out of its carrying-hooks bracket on the vehicle (fig. 40), thus removing the carrying hook on this side.
- (9) Pull the center shaft out of the left shaft (fig. 39).
- (10) Pull the left shaft (fig. 39) out of its carrying-hooks bracket on the vehicle (fig. 40), thus removing the carrying hook on this side.

**b. INSTALLATION.**

- (1) Hold one carrying hook (fig. 39) between the two bosses of the left carrying-hooks bracket (fig. 40) and install the left shaft in this bracket by pushing it through the inner boss, the carrying hook, and the outer boss.

*Note.* The shaft end having the threaded bore near the end is at the inner side.



A—CARRYING HOOK  
B—DRUM BODY  
C—CENTER SHAFT

D—LEFT SHAFT  
E—BRACKET  
F—RIGHT SHAFT RA PD 124026

*Figure 40. Carrying books and shaft installed.*

- (2) Locate the carrying hook on the left shaft to align the set screw (fig. 39) in the hook with the bore in the shaft; and tighten the set screw to secure the hook onto the shaft.
- (3) Insert the plain end of the center shaft (fig. 39) through the left shaft, pushing it as far through as possible.
- (4) Install the other carrying hook and the right shaft (fig. 39) in the manner outlined in (1) and (2) above.

*Note.* Flange of right shaft is at inner end.

- (5) Place the open side of the drum body (fig. 39) against the flange of the right shaft, slide the center shaft over to butt

the flange of this shaft against the drum body, align the bolt holes in the two flanges and the drum body, and secure these parts together with two bolts, lock washers, and nuts.

- (6) Align the bore at the inner end of the left shaft with the threaded bore in the center shaft and secure these two shafts together with a cap screw and lock washer (fig. 39).
- (7) Pass the end of the carrying-hooks cable to which the turnbuckle is not attached over the drum body (fig. 39) and wrap cable around drum one and one-half times.
- (8) Attach cable end to turnbuckle (fig. 39) with a cap screw, lock washer, and nut.
- (9) Raise the moldboard (par. 43) to its highest position, engage both carrying hooks with the carrying-hooks engagement pins, and place the control-valve operating lever at "FLOAT" position.
- (10) Position the hand-control shaft (fig. 31) at the "CARRYING HOOKS DOWN" position.
- (11) Clamp the cable to the drum body (fig. 39) by securing the drum block with a cap screw and lock washer. Be sure to insert screw between the two coils of the cable.
- (12) Install hydraulic-piping lower guard (par. 64).

## **67. Hydraulic Cylinders**

### **a. REMOVAL.**

- (1) Remove all hydraulic-piping guards (par. 64).
- (2) Disconnect at the hose unions (fig. 22) the two hoses connected to the upper and lower ends of each cylinder.
- (3) Block up the lift link to keep it from dropping, and remove the two bolts, lock washers, and pins which connect this link to the two hydraulic-cylinder piston rams (fig. 23).
- (4) If markings on the three cylinder-bracket caps and brackets are not clear, mark caps and brackets so the caps can be installed in their original positions during assembly.
- (5) Remove four bolts from each and remove the three bracket caps from the brackets.
- (6) Lift each cylinder out of its brackets.

### **b. INSTALLATION.**

- (1) Position each cylinder in its brackets.

*Note.* Cylinders are installed with the hose connections toward center line of vehicle (fig. 23).

- (2) Position the three bracket caps as per markings made during removal, and secure each with four bolts.

- (3) Aline each cylinder-piston-ram bore with the associated bracket bore on the lift link, and install the pin which connects the ram to the lift link. This pin is inserted from outer side toward inner side.
- (4) Secure each pin with a lock washer and bolt.
- (5) Attach the two hoses (fig. 22) which connect each cylinder with the hydraulic piping at the front of the vehicle. These are attached at the hose unions. Be careful not to twist hoses.
- (6) Install the three hydraulic-piping guards (par. 64).

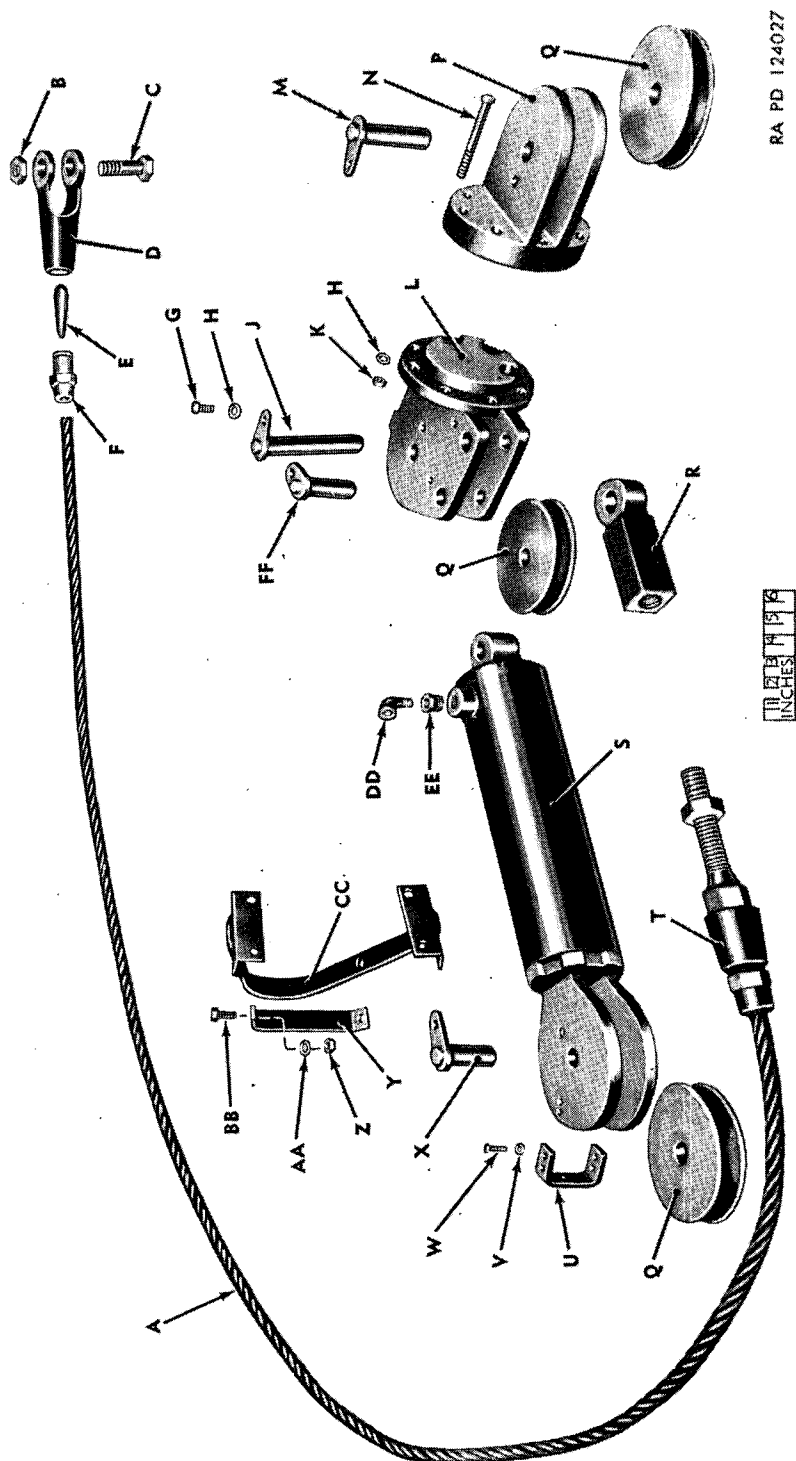
## **68. Emergency-Lift Cable**

### **a. REMOVAL.**

- (1) Remove the nut and pin (fig. 41), and disconnect the cable clevis from the bracket on the right tilt arm (fig. 27).
- (2) Remove the clevis part from the cable end sleeve, pry out the grooved plug from the sleeve, and pull the sleeve off of the cable.
- (3) Pull the end of the cable from which clevis has been removed into the interior of the vehicle, and free the cable from the sheave at the bottom of the emergency-lift jack (fig. 30).
- (4) Remove the cap screw and lock washer which secure the cable connector pin (fig. 41) to the sheave inner support.
- (5) Remove cable.

### **b. INSTALLATION.**

- (1) Thread the plain end of the cable down between the jack ram emergency-lift cable sheave (fig. 41) and the cable clip, turn the cable up around the sheave, and pass the plain end out of the vehicle (fig. 30) by threading it over the sheaves in the inner and outer supports.
- (2) Wrap the plain end with wire for a distance of  $\frac{1}{2}$ -inch, at each of three places approximately  $\frac{1}{2}$ -inch, 3 inches, and 6 inches from the end.
- (3) Push the cable end sleeve, plain end first, over the cable end far enough to prevent cable from fanning out, and remove the first wire wrap.
- (4) Insert a screwdriver blade into center of cable strands to spread them, pry out the hemp center, and cut the hemp center off just above the center wire wrap.
- (5) Push the cable end sleeve down over the cable far enough to insert the grooved plug, pointed end first, among the cable strands, so that each strand lies in a groove of the plug.



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Figure 41. Hydraulic jack, sheaves, sheave supports, and emergency-lift cable.

- (6) Alternately tap the sleeve and plug to drive them onto the cable until lower end of sleeve is approximately  $3\frac{5}{16}$  inches from end of cable. Drive plug in to seat it solidly.
- (7) Compress the protruding cable strands as necessary, and install the clevis part on the sleeve.
- (8) Attach the clevis to the bracket on the right tilt arm (fig. 27), using the pin and nut (fig. 41).

*Note.* Do not tighten nut so tight that clevis cannot rotate freely on the pin.

- (9) Lower the moldboard (par. 43) as far as it will go.
- (10) From inside vehicle, pull the cable tight; but make certain that the ram of the emergency-lift jack is raised up as far as possible into the jack cylinder.
- (11) Adjust the cable connector (fig. 41) by turning it down on, or up off of the threaded cable end until the connector

*Figure 41—Continued.*

A—CABLE, EMERGENCY LIFT—7705109  
 B—NUT— $\frac{7}{8}$ -14NF-2—114500  
 C—PIN, CLEVIS—7074503  
 D—CLEVIS, CABLE—7074506  
 E—PLUG, CLEVIC—7074512  
 F—SLEEVE, CLEVIS—7074509  
 G—SCREW— $\frac{3}{8}$ -24NF X  $\frac{3}{4}$ —123520  
 H—WASHER, LOCK— $\frac{3}{8}$ -IN—120382  
 J—PIN— $5\frac{9}{16}$  X 0.995—7705089  
 K—NUT— $\frac{3}{8}$ -24NF-3—121932  
 L—SUPPORT, SHEAVE, INNER—7705055  
 M—PIN—3 $\frac{3}{4}$  X 0.995—7705087  
 N—SCREW— $\frac{3}{8}$ -24NF-2 X 3 $\frac{3}{4}$ —224044  
 P—SUPPORT, SHEAVE, OUTER—7705107  
 Q—SHEAVE, CABLE—7705114  
 R—CONNECTOR, CABLE (ANCHOR END)—7704960  
 S—JACK, HYDRAULIC, EMERGENCY LIFT—7704975  
 T—END, CABLE (ANCHOR END)—7705046  
 U—CLIP, CABLE—7705111  
 V—WASHER, LOCK— $\frac{1}{4}$ -IN.—120380  
 W—SCREW— $\frac{1}{4}$ -28NF-3 X  $\frac{3}{4}$ —123450  
 X—PIN—2 $\frac{5}{8}$  X 0.995—7705084  
 Y—BRACE, SUPPORTING BRACKET—7705086  
 Z—NUT— $\frac{1}{2}$ -20NF-2—214267  
 AA—WASHER, LOCK— $\frac{1}{2}$ -IN.—120384  
 BB—SCREW— $\frac{1}{2}$ -20NF-3 X 1—123605  
 CC—BRACKET, HYDRAULIC JACK—7705090  
 DD—ELBOW—90-DEG,  $\frac{1}{4}$ -IN—105423  
 EE—BUSHING— $\frac{1}{2}$  X  $\frac{1}{4}$ —116524  
 FF—PIN—3-/16 X 0.995—7704971

can just be attached to the sheave inner support when cable is tight.

- (12) Attach connector to support (fig. 41), using the cable connector pin, lock washer, and cap screw.

## **69. Emergency-Lift Hydraulic Jack**

### **a. REMOVAL.**

- (1) Remove the cap screw, lock washer, and cable connector pin (fig. 41) and disconnect the emergency-lift cable from the sheave inner support.
- (2) Remove two cap screws and lock washers (fig. 41), remove the emergency-lift cable clip from the bottom end of the jack, and free the cable from the jack.
- (3) Remove the two cap screws, lock washers, and nuts which secure the jack support bracket brace to the bracket, and remove the brace.
- (4) Remove the hose which connects the jack to the emergency-lift pump (fig. 30).
- (5) Remove the cap screw, lock washer, and emergency-lift jack pin (fig. 41) and lift the jack out of the vehicle.

### **b. INSTALLATION.**

- (1) Lift the jack into place (fig. 30) inside the support bracket (fig. 41), alining the eye at the top of the jack with the pin bore in the sheave inner support.
- (2) Install the emergency-lift jack pin (fig. 41) and secure it with a cap screw and lock washer.
- (3) Install the jack support bracket brace in the bracket, using the two cap screws, lock washers, and nuts (fig. 41).
- (4) Install the hose which connects the jack to the emergency-lift pump (fig. 30).
- (5) Place the emergency-lift cable around the sheave at the bottom of the jack and install the cable clip, using two cap screws and lock washers (fig. 41), to hold cable in place.
- (6) Lower the moldboard (par. 43) as far as it will go.
- (7) From inside vehicle, pull the emergency-lift cable tight; but make certain that the jack ram is raised all the way up into the jack cylinder.
- (8) Adjust the cable connector (fig. 41) by turning it down on, or up off of the threaded cable end until the connector can just be attached to the sheave inner support when cable is tight.
- (9) Attach cable connector to sheave inner support (fig. 41), using the cable connector pin, lock washer, and cap screw.

## 70. Emergency-Lift Cable Sheave Supports

*Note.* The emergency-lift cable sheaves can each be removed from their sheave supports by removing the cap screws, lock washers, and pins which secure them (fig. 41). When the pin is removed from the inner support, the carrying hooks cable drum (fig. 39), installed on the projecting end of this pin, will drop down and must be held up in place when pin is installed.

### a. REMOVAL.

- (1) Remove emergency-lift cable (par. 68).
- (2) Remove emergency-lift jack (par. 69).

*Note.* If only the outer support is to be removed, the jack need not be removed.

- (3) Remove the carrying-hooks cable (par. 65).
- (4) Remove the eight screws, lock washers, and nuts (fig. 41) which attach the outer support to the inner support, and remove both supports from the vehicle.

### b. INSTALLATION.

- (1) Have one operator hold the inner support in place in the cal. .30 machine-gun port on the inside of the vehicle.
- (2) Have another operator hold the outer support in place in the cal. .30 machine-gun port on the outside of the vehicle.
- (3) Install eight screws, lock washers, and nuts (fig. 41) to secure the two supports together in the machine-gun port.
- (4) Install the emergency-lift jack (par. 69).
- (5) Install emergency-lift cable (par. 68).
- (6) Install carrying-hooks cable (par. 65).

## 71. Emergency-Lift Hand-Operated Pump

### a. REMOVAL.

- (1) Move the release valve lever (fig. 33) to the open position (par. 44).
- (2) Remove the hose (fig. 30) which connects the pump to the emergency-lift jack.
- (3) Remove the oil reservoir (filler) plug (fig. 33).
- (4) Use a suction pump to remove all oil from the reservoir.

*Note.* If more convenient, pump can be removed with oil in reservoir, if care is taken not to upset it and spill oil out. In this case, oil can be drained after pump is removed.

- (5) Remove four cap screws and lock washers which secure the bottom of the pump reservoir to the pump mounting plates welded to the vehicle floor (fig. 30), and lift pump out of the vehicle.



#### **b. INSTALLATION.**

- (1) Position the pump on top of the pump mounting plates welded to the vehicle floor (fig. 30), and secure it in place with four cap screws and lock washers.

*Note.* Pump is positioned with the hose outlet toward front of the vehicle.

- (2) Install the hose which connects the pump to the emergency-lift jack (fig. 30).
- (3) Move the moldboard to its lowest position (par. 43).
- (4) Fill the pump reservoir with hydraulic oil (OH). Total capacity is approximately 1 gallon.
- (5) Install the oil reservoir (filler) plug (fig. 33).
- (6) Operate the emergency-lift pump (par. 44) to raise and lower the moldboard several times; then remove the filler plug, add oil as required to fill the reservoir, and install the plug.

## **72. Control Valve Operating Lever, Lever Locks, and Bracket**

#### **a. OPERATING LEVER.**

##### **(1) Removal.**

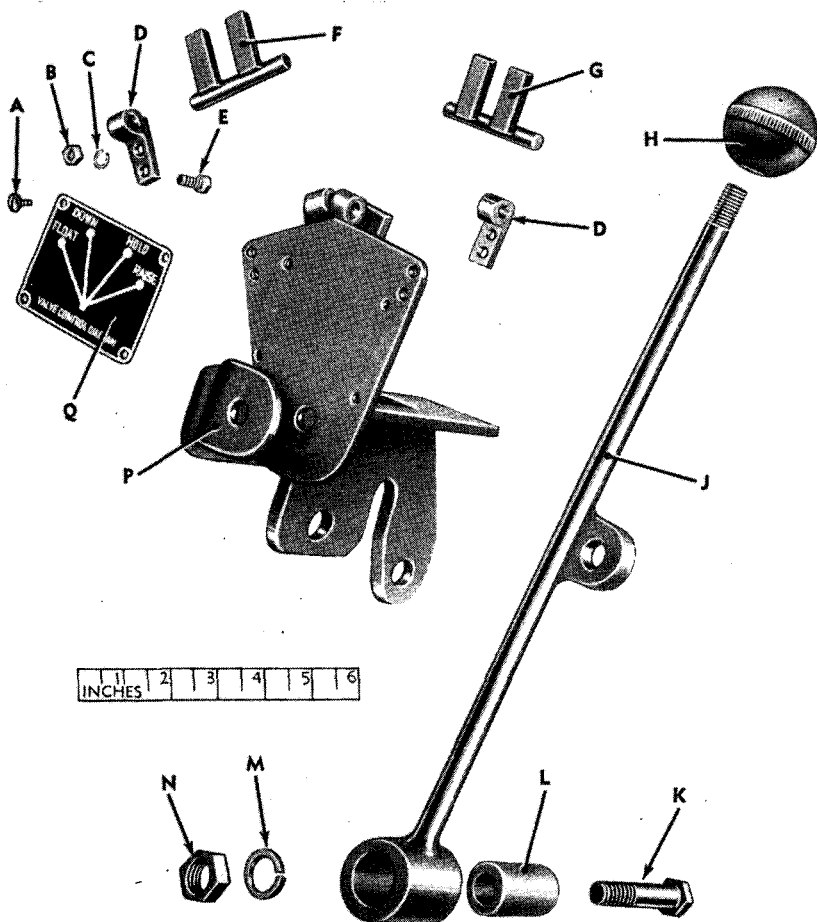
- (a) Remove split cotter pin and pin which attach the control rod to the lever, and detach the control rod.
- (b) Remove nut, lock washer, and screw (fig. 42) which secure the lever to the bracket, and lift lever (with the operating lever shaft inside the lever sleeve) away from the bracket.
- (c) Remove shaft from sleeve by lifting it out.

##### **(2) Installation.**

- (a) Insert the operating lever shaft (fig. 42) into the sleeve at the bottom of the lever, and position lever in the bracket.

*Note.* The integral eye for attachment of the control rod faces the rear of the vehicle.

- (b) Install the screw, lock washer, and nut which secure the lever to the bracket.
- (c) Move the lever to the "HOLD" position indicated on the instruction plate, and rotate the operating lever rear lock down to secure the lever in this position.
- (d) Move the control rod until there is a distinct feeling that the hydraulic pump control valve has "settled" into a position from which it cannot be moved without an "extra little" effort.
- (e) Without further moving the control rod, adjust the adjustable rod end yoke as necessary, and attach the yoke to the operating lever with the pin and split cotter pin.



- A — SCREW — No 10 (0.190)24NC-2 X  $\frac{3}{8}$  — 171388  
 B — NUT —  $\frac{1}{4}$ -28NF-2 — 218584  
 C — WASHER, LOCK —  $\frac{1}{4}$ -IN — 120380  
 D — SUPPORT, LEVER LOCK — 7705081  
 E — SCREW —  $\frac{1}{4}$ -28NF-3 X  $\frac{7}{8}$  — 123456  
 F — LOCK, OPERATING LEVER, FRONT — 7705132  
 G — LOCK, OPERATING LEVER, REAR — 7705133  
 H — KNOB, BALL, OPERATING LEVER — A187841  
 J — LEVER, OPERATING, CONTROL VALVE — 7705064  
 K — SCREW —  $\frac{1}{2}$ -20NF-3 X 3 — 124193  
 L — SHAFT, OPERATING LEVER (1 X  $1\frac{1}{4}$ ) — 7705072  
 M — WASHER, LOCK —  $\frac{1}{2}$ -IN — 120384  
 N — NUT —  $\frac{1}{2}$ -20NF-2 — 214267  
 P — BRACKET, SUPPORTING, CONTROL VALVE OPERATING LEVER — 7704967  
 Q — PLATE, INSTRUCTION, OPERATING LEVER — 7705099

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Figure 42. Control valve operating lever, bracket, and instruction plate.

**b. LEVER LOCKS.**

- (1) *Removal.* Remove cap screw, lock washer, and nut (fig. 42) which attach each operating lever lock support to the bracket, and remove support and lock.
- (2) *Installation.* Insert short end of each lock pin in the sleeve formed at top of bracket, and place the operating lever lock support (fig. 42) over the long end of the lock pin and against the bracket. Secure the support to the bracket with a cap screw, lock washer, and nut.

**c. OPERATING LEVER SHAFT SUPPORTING BRACKET.**

- (1) *Removal.*
  - (a) Remove the operating lever (b(1) above).
  - (b) Remove the bolt, lock washer, and nut which secure the hydraulic cylinder inlet and outlet rear pipe clamp (fig. 21) to the bracket, and detach the clamp and pipes.
  - (c) Remove the two bolts which attach the bracket to the vehicle transmission housing, and remove the bracket.
- (2) *Installation.*
  - (a) Position the bracket on the vehicle transmission housing (fig. 21) and secure it with two bolts (which are part of the housing installation).
  - (b) Install the hydraulic cylinder inlet and outlet rear pipe clamp (fig. 21), together with the ends of the two pipes by securing the clamp to the bracket with a bolt, lock washer, and nut.
  - (c) Install the operating lever (b(2) above).

### **73. Hydraulic Pump Control Valve**

**a. REMOVAL.**

- (1) Remove the split cotter pin and pin which connect the clevis at the back end of the control rod (fig. 20) to the control rod to valve stem head link on the control valve.
- (2) Disconnect the rubber hose from the 1-inch hose union at the outlet side of the hydraulic pump (fig. 20).
- (3) Remove the above hose, by breaking the line to the control valve between the 1 x 5½-inch nipple (fig. 20) and the 1-inch 90° elbow.
- (4) Disconnect the two hydraulic cylinder inlet and outlet rear pipes (fig. 20) from the valve at the 1-inch pipe unions installed at the right side of the valve.
- (5) Remove four bolts and lock washers (fig. 53) which attach the valve to the hydraulic oil reservoir, and remove the valve and gasket from the reservoir.

**b. INSTALLATION.**

- (1) Place a new gasket (fig. 53) over the mounting pad at the top of the hydraulic oil reservoir, and position the valve on top of this gasket with the control rod to valve stem head link at the right side.
- (2) Secure the valve to the reservoir with four bolts and lock washers (fig. 53).
- (3) Connect the two hydraulic cylinder inlet and outlet rear pipes to the valve at the 1-inch pipe unions (fig. 20) on the right side of the valve.
- (4) Connect the assembly consisting of the rubber hose, 1-inch coupling, and 1 x 5½-inch nipple (fig. 20) to the 1-inch 90° elbow which is at the end of the line of fittings installed at the left side of the valve. Position fittings as shown in figure 20.
- (5) Connect the free end of the rubber hose to the 1-inch hose union (fig. 20) installed in the line at the outlet side of the hydraulic pump.
- (6) Attach the control rod end to the control rod to valve stem head link with a pin and split cotter pin.

*Note.* If control rod has not been turned, it will not need adjustment ; but if an adjustment is required, refer to paragraph 19 *q* through *s*.

## **74. Hydraulic Pump Reservoir**

**a. REMOVAL.**

- (1) Remove the filler cap and use a suction pump to remove all oil from the reservoir.
- (2) Remove hydraulic pump control valve (par. 73).

*Note.* Reservoir can be removed with valve attached. In this case, perform only *a* (1) through (4) of paragraph 73.

- (3) Remove three cap screws and lock washers which attach the outlet-pipe flange (fig. 20) to the reservoir, hold flange away from reservoir, and remove the flange gasket.
- (4) Remove the bolt, three washers, and nut which secure the upper right corner of the reservoir to the left floor support angle of the vehicle.
- (5) Remove the four bolts, lock washers, and plain washers which attach the base of the reservoir to the vehicle floor, and lift reservoir out of vehicle.

**b. INSTALLATION.**

- (1) Position the reservoir in the vehicle over the tapped bolt holes in the floor plate, and with the filler cap (fig. 17) at the left side.

- (2) Install four bolts, lock washers, and plain washers to secure the reservoir to the floor plate.
- (3) Install one bolt, with a plain washer under the head, through the bracket at the front right corner of the reservoir and through the hole in the left floor support angle of the vehicle. Secure this bolt with a plain washer, lock washer, and nut.
- (4) Place the outlet pipe flange gasket over the mounting pad at the lower front side of the reservoir, position the flange over the gasket, and secure the flange with three cap screws and lock washers.
- (5) Install the hydraulic pump control valve (par. 73).
- (6) Fill the reservoir with hydraulic oil, and install the filler cap. Total capacity of hydraulic system is approximately 16 gallons.
- (7) Operate the power-driven hydraulic system (par. 43) to raise and lower the moldboard several times.
- (8) Bring the oil level in the reservoir up to the level cock (fig. 35).

*Note.* Oil level can be checked by opening the cock slightly to let several drops spill out when correct level is reached.

## **75. Hydraulic Pump Support**

### *a.* REMOVAL.

- (1) Disconnect the rubber hose from the 1-inch hose union at the outlet side of the hydraulic pump (fig. 20).
- (2) Remove the filler cap and use a suction pump to remove all oil from the reservoir.
- (3) Remove three cap screws and lock washers which attach the outlet-pipe flange (fig. 20) to the reservoir, hold the flange away from the reservoir, and remove the flange gasket.
- (4) Loosen the hydraulic pump adjusting screw nut, and rotate the adjusting screw (fig. 19) counterclockwise sufficiently to loosen the three bolts.
- (5) Remove belts from the driven pulley.
- (6) Remove the four bolts and lock washers which attach the support to the two pump mounting plates (fig. 15).
- (7) Lift the support (with the pump and driven pulley attached) out of the vehicle.

*Note.* For removal of pump and driven pulley from the support, refer to paragraph 76.

### *b.* INSTALLATION.

- (1) Lower the pump support (with pump and driven pulley attached) onto the two pump mounting plates (fig. 15), alining

the bolt holes in the support with those in the plates.

*Note.* Support is installed with driven pulley at left side.

- (2) Secure the support to the plates with four bolts and lock washers; but do not tighten bolts.
- (3) Place the three belts over the driven pulley.
- (4) Tighten the hydraulic pump adjusting screw (rotate clockwise) to move the support away from the drive pulley (fig. 19) until the tension of the three belts is such that finger pressure at the top center of each belt will result in approximately a  $\frac{1}{2}$ -inch belt deflection. Secure the adjustment by tightening (rotate clockwise) the adjusting screw nut.
- (5) Tighten the four bolts that secure the support to the mounting plates.
- (6) Connect the rubber hose (fig. 20), between the hydraulic pump control valve and the pump, at the 1-inch hose union on the outlet side of the pump.
- (7) Place the outlet pipe flange gasket over the mounting pad at the lower front side of the reservoir, position the flange (fig. 20) over the gasket, and secure the flange to the reservoir with three cap screws and lock washers.
- (8) Fill the hydraulic reservoir with hydraulic oil and install the filler cap. Total capacity of hydraulic system is approximately 16 gallons.
- (9) Operate the power-driven hydraulic system (par. 43) to raise and lower the moldboard several times.
- (10) Bring the oil level in the reservoir up to the level cock.

*Note.* Oil level can be checked by opening the cock slightly to let several drops of oil spill out when correct level is reached.

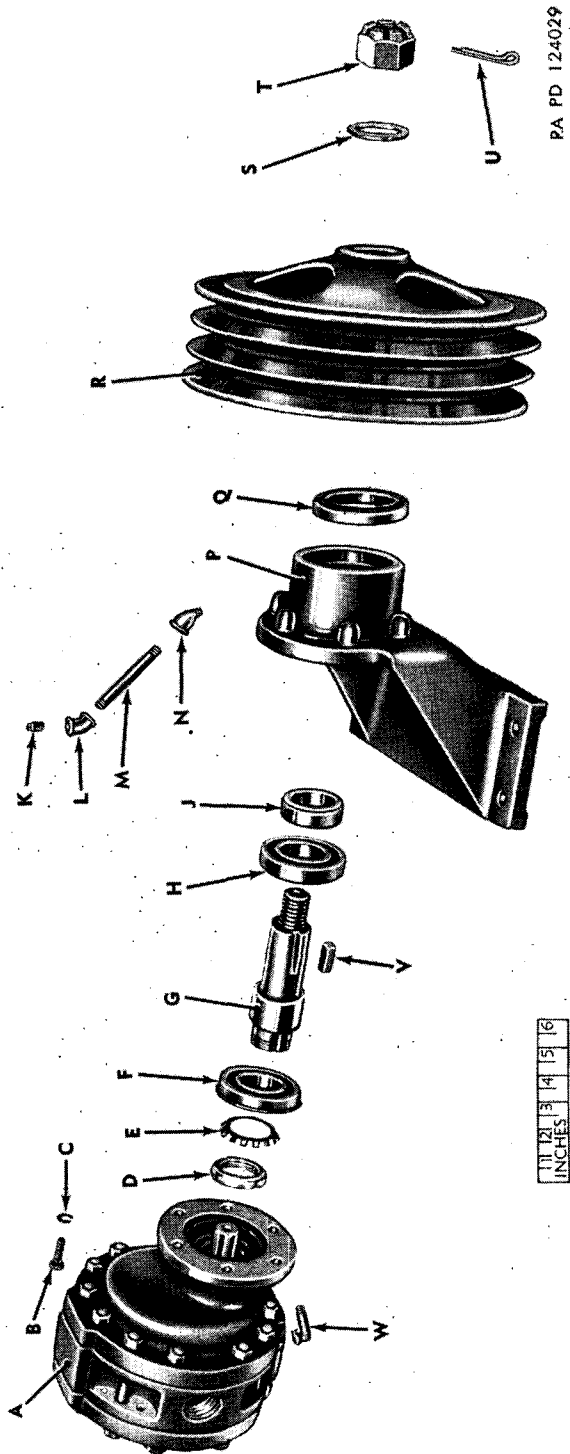
## **76. Hydraulic Pump and Hydraulic Pump Driven Pulley**

### **a. REMOVAL.**

- (1) Remove six bolts and lock washers (fig. 43) which attach the hydraulic pump to the pump support, and remove the pump.
- (2) Remove hydraulic pump support (par. 75).
- (3) Remove the split cotter pin, castle nut, and plain washer (fig. 43) from the end of the pump pulley driven shaft.
- (4) Remove the driven pulley from the shaft, using a gear puller (fig. 44).

*Note.* The key used to seat the pulley on the shaft does not come off with the pulley.

Lift the key from the slot in the shaft.



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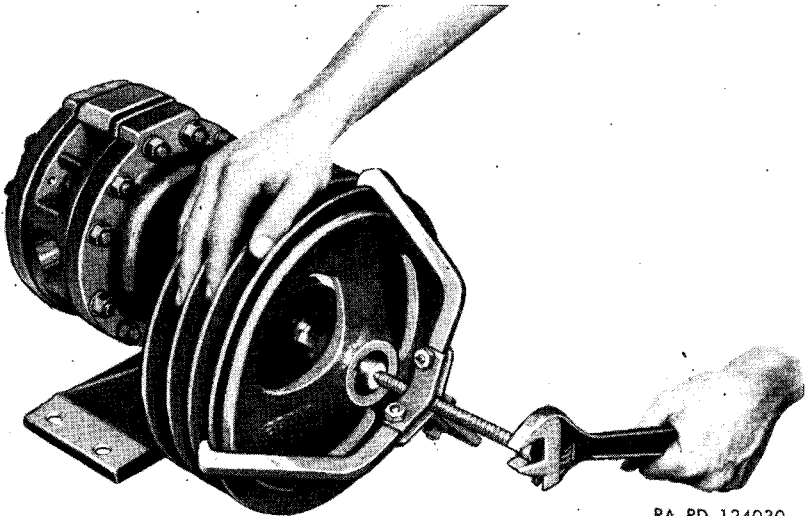
Figure 43. Hydraulic pump, pump support, and driven pulley.

Figure 43—Continued.

A—PUMP, HYDRAULIC—7323579  
B—SCREW— $\frac{3}{8}$ -16NC-3 X  $1\frac{3}{8}$ —122150  
C—WASHER, LOCK— $\frac{3}{8}$ -IN—120382  
D—NUT, LOCK, BALL BEARING—711015  
E—WASHER, LOCK—1.625 BORE, 1.5748 BEARING BORE, 6 OR 12 PRONGS—711209  
F—BEARING, BALL, HYDRAULIC PUMP-DRIVEN PULLEY SHAFT, INNER—700780  
G—SHAFT, DRIVEN PULLEY—7323869  
H—BEARING, BALL, HYDRAULIC PUMP-DRIVEN PULLEY SHAFT, OUTER—700081  
J—SLEEVE, OUTER BEARING—7323858  
K—PLUG, PIPE— $\frac{1}{8}$ -IN—103865  
L—ELBOW, PIPE—45-DEG  $\frac{1}{8}$ —105414  
M—NIPPLE, PIPE— $\frac{1}{8}$  X 3—115075  
N—ELBOW, PIPE—45-DEG  $\frac{1}{8}$ —106649  
P—SUPPORT, PUMP—7323877  
Q—SEAL, OIL— $2\frac{1}{4}$  X 3.256 X  $\frac{1}{2}$ —500143  
R—PULLEY, DRIVEN, HYDRAULIC PUMP—7323872  
S—WASHER, PLAIN— $1\frac{1}{16}$  ID X 2 OD X  $\frac{1}{8}$ —131019  
T—NUT—1-14NF-2—109879  
U—PIN— $\frac{1}{4}$  X 2—103422  
V—KEY, SQUARE—542683  
W—CUP, OIL—7323839

b. INSTALLATION.

- (1) Position the pump against the flange of the support (fig. 43), mating the splined end of the shaft in the pump with the splined opening in the end of the driven shaft.
- (2) Aline the bolt holes in the adapter on the pump with those in the flange of the support, keeping the pump turned so that the adapter is at the lowest position.



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Figure 44. Removing hydraulic pump driven pulley.



- (3) Install six bolts and lock washers (fig. 43) to secure the pump to the support.
- (4) Place the key (fig. 43) in the slot of the driven shaft. Press the driven pulley onto the shaft to seat it properly on the key.

*Note.* A sleeve approximately 2 inches long and having an inside diameter large enough to fit over the shaft end can be used to tap the pulley onto the shaft with a hammer, if an arbor press is not available.

- (5) Install the plain washer and castle nut (fig. 43) on the shaft end. Secure the nut with a new split cotter pin.
- (6) Install pump support (par. 75).

## 77. Hydraulic Pump Drive Pulley and Flange

### a. REMOVAL.

- (1) Loosen the hydraulic pump adjusting screw nut, and rotate the adjusting screw (fig. 19) counterclockwise sufficiently to loosen the three pump drive belts.
- (2) Remove belts from the drive pulley.
- (3) Cut the lock wire and remove eight bolts which secure the pulley (fig. 16) to the flange.
- (4) Remove vehicle propeller shaft (TM 9-759).
- (5) Slide pulley off propeller shaft.
- (6) Cut lock wire and remove eight shoulder bolts and castle nuts which secure the flange to the clutch shaft coupling flange, and remove the flange.

### b. INSTALLATION.

- (1) Install the drive pulley flange on the clutch shaft coupling flange, securing it with eight shoulder bolts (passed from back to front through the clutch shaft coupling flange, the drive pulley flange, and the universal-joint flange) and castle nuts. Install a separate lock wire on each pair of nuts.
- (2) Slide the drive pulley over the rear end of the vehicle propeller shaft, with the grooved end of the pulley toward the front end of the vehicle.
- (3) Lower propeller shaft into approximate position in vehicle and place the three pump drive belts over the shaft, in front of the pulley.
- (4) Install the propeller shaft in the vehicle (TM 9-759).
- (5) Slide the drive pulley rearward on the propeller shaft and attach it to the drive pulley flange with eight bolts.

*Note.* When positioning the pulley against the flange, make certain that one or the other of the two holes in the pulley is directly over the lubrication fitting in the propeller shaft universal joint (fig. 16). If the locating dowel in the edge of the pulley will not permit one hole to be over the lubrication fitting, rotate the pulley to place the second hole over the fitting.

## **CHAPTER 4**

### **ORDNANCE MAINTENANCE INSTRUCTIONS**

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#### **Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE**

##### **78. General**

Tools and equipment and additional spare parts over and above those available to the using organization are supplied to ordnance field maintenance units and depots for maintaining, repairing, and/or rebuilding the matériel.

##### **79. Parts**

Parts are listed in Department of the Army Supply Catalog ORD 7-8 SNL G-247, which is the authority for requisitioning replacements. Parts not listed in the catalog, but required by depot shops in rebuild operations, may be requisitioned from the listing in the corresponding ORD 9 catalog.

##### **80. Common Tools and Equipment**

Standard and commonly used tools and equipment having general application to this matériel are listed in Department of the Army Supply Catalog ORD 6 SNL G-27, Section II, which is the authority for requisitioning replacements. They are not specifically identified in this manual.

##### **81. Special Tools and Equipment**

No special tools or equipment for field and depot maintenance on the tank-mounting bulldozer M2 are required.

##### **82. Improved Tools**

Information furnished in this paragraph is intended for depots, arsenals, and all other corresponding organizations performing major

overhaul work on the tank-mounting bulldozer M2. The chief value of these tools is to maintenance organizations engaged in rebuilding a large number of identical components. These tools are listed in table IV and are not available for issue; the list is furnished for information only.

*Table IV. Improvised tools for field and depot maintenance*

Item	References		Use
	Fig.	Par.	
PLATE-----	45, 50	95, 97	To hold hydraulic pump for bench work.
REMOVER, bearing, wedge-type.	45, 48	95	To raise hydraulic pump bearings to permit use of puller.
PULLER, bearing-----	45, 49	95	To remove hydraulic pump bearings.
REPLACER, oil seal seat---	45	97	To install hydraulic pump oil seal seat.
REPLACER, bearing-----	45	97	To install hydraulic pump bearings.

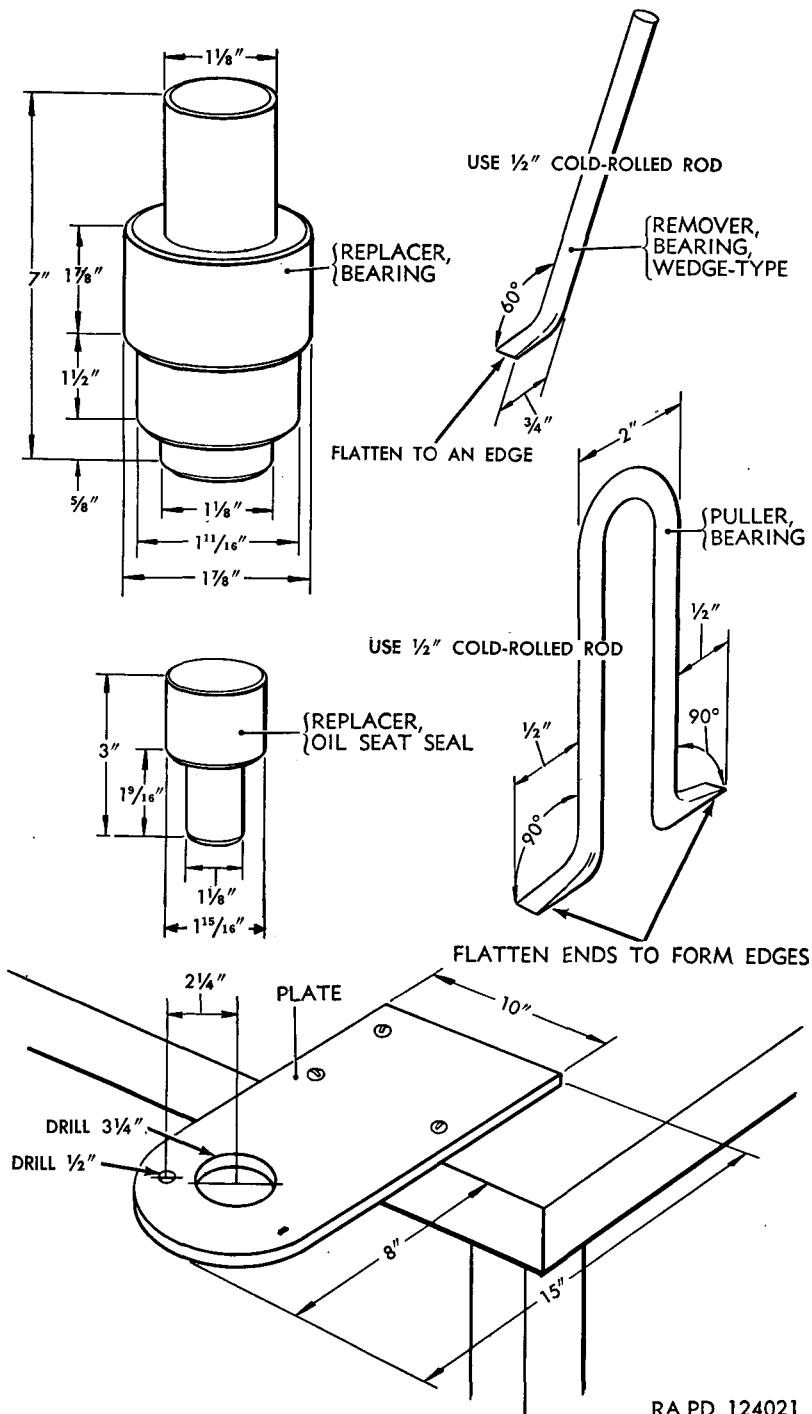


Figure 45. Improvised tools.

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## Section II. TROUBLE SHOOTING

### 83. Scope

*Note.* Information in this section is for the use of ordnance maintenance personnel in conjunction with, and as a supplement to, the trouble-shooting information given in section IV, chapter 3. It provides a continuation of the above trouble-shooting instructions, where a remedy in those instructions refers to ordnance maintenance personnel for corrective action.

Operation of a malfunctioning bulldozer without preliminary examination can cause further damage to a disabled component, and possible injury to personnel. By careful inspection and trouble-shooting, such damage and injury can be avoided and, in addition, the causes of faulty operation often can be determined without extensive disassembly. As an aid in trouble-shooting, always obtain all possible information from the organizational group, and particularly from the operator of the bulldozer in question. Full information as to symptoms often will make it possible to quickly isolate the trouble and repair the damage.

### 84. Power-Driven Hydraulic System

*a. CONTROL VALVE OPERATING LEVER WILL NOT MOVE.* Interference with operating lever movement, if not already traced by the using organization personnel (par. 57*a*) to an obstruction of the control rod, will probably be found to be caused by a bent valve stem head or rotor shaft in the control valve (fig. 54). Remove the control valve (par. 73), then disassemble it and install new parts (par. 102), as required. Reinstall the control valve (pars. 19 and 73).

*b. MOLDBOARD FAILS TO MOVE.*

*Note.* Make certain that using organization personnel have taken all steps outlined in paragraph 57*b*.

- (1) *Failure of hydraulic pump drive.* With the vehicle engine in operation, squeeze the hose connected between the control valve and the outlet side of the pump (fig. 20). If the pump is operating properly, it will be possible to feel the oil flow through this hose. Lack of "internal vibration" in the pump will also be noted, if there is a failure in the mechanical drive. Such a failure would most likely be caused by shearing of the square key which locks the hydraulic-pump driven pulley to its shaft (fig. 43). Remove the pump, pump support, and driven pulley, disassemble this assembly and install new parts as required, then reassemble and install the assembly (pars. 75, 76, and 97).

- (2) *Malfunction of hydraulic pump.*—Pump failure can be caused by external oil leakage around one of the gaskets at each side of the pump housing (fig. 47), external leakage around the oil seal in the adapter-end cover, shearing of the key which locks the drive gear to its shaft (in which case pump would make a distinct noise), or by excessive wear and/or failure of working parts. Remove pump (par. 76); overhaul it as required (pars. 95 to 97); then reinstall pump (pars. 18 and 19).
- (3) *Malfunction of hydraulic pump control valve.* Valve failure can be caused by external oil leakage around one of the gaskets or around the valve-stem oil seal (fig. 54), by fatigue of the relief-valve spring or the check-valve-pusher spring, or by excessive wear and/or failure of working parts. Remove valve (par. 73), overhaul it as required (pars. 100 to 102), then reinstall valve (pars. 19 and 73).
- (4) *Malfunction of hydraulic cylinders.* Failure of either cylinder can be caused by distortion of the piston ram (fig. 59), by external oil leakage around the piston ram seal or ram packing, by internal oil leakage around the piston packing, or by damage to any working parts of the cylinder. Remove cylinder (par. 67); overhaul it as required (pars. 112 to 114); then reinstall cylinder (par. 20).

**c. MOLDBOARD MOVES TOO SLOWLY, OR SETTLES SLOWLY WHEN CONTROL VALVE LEVER IS AT "HOLD."**

*Note.* Make certain that using organization personnel have taken all steps outlined in paragraph 57 *c* and *d*.

- (1) *Control valve leaking oil.* Inspect the control valve for external and/or internal oil leaks. External leaks can be caused by failure of one of the gaskets, or of the valve stem oil seal (fig. 54). Internal oil leaks can be caused by excessive wear of the relief valve or check valve. Remove valve (par. 73); overhaul it as required (pars. 100 to 102); then reinstall valve (pars. 19 and 73).
- (2) *Hydraulic pump leaking oil.* Inspect the hydraulic oil pump for external and/or internal oil leaks. External leaks will be caused by failure of one of the gaskets at each side of the pump housing (fig. 47), or of the oil seal in the adapter end cover. Internal leaks would most likely be caused by excessive wear of the gears or wear plates, or by failure of the check valve plunger springs. Remove pump (par. 76); overhaul it as required (pars. 95 to 97); then reinstall pump (pars. 18 and 19).

(3) *Hydraulic cylinders leaking oil.* Refer to b(4) above.

d. **MOLDBOARD MOVES IN ONE DIRECTION BUT FAILS TO MOVE IN THE OTHER DIRECTION; OR MOLDBOARD FAILS TO "FLOAT" WHEN CONTROL LEVER IS MOVED TO THIS POSITION.** Most likely cause would be failure of the check valve spring in the control valve. Remove valve (par. 73); install new check valve spring (pars. 100 to 102); and then re-install valve (pars. 19 and 73).

## 85. Moldboard Linkages

a. **MOLDBOARD FAILS TO RAISE HIGH ENOUGH FOR ENGAGEMENT OF CARRYING HOOKS.**

- (1) *Worn or bent pins.* Inspect the pins which connect the moldboard to the lift link, push beams, and tilt arms, and also the pins which connect these parts to the brackets at the front of the vehicle. Remove any pins that are worn or damaged, and install new pins as required (pars. 62 and 63).
  - (2) *Distortion of mechanical linkages.* Inspect the tilt arms, push beams, push-beam links, and the lift link (figs. 23, 24, and 25) for distortion. Remove damaged parts and install new parts as required (pars. 62 and 63).
  - (3) *Distortion of hydraulic cylinder piston rams.* Refer to paragraph 84 b(4).
  - (4) *Worn piston on ram bushing bearings in hydraulic cylinders.* Install new bushings as required (pars. 112 to 114).
- b. **MOLDBOARD FAILS TO "DIG IN" PROPERLY.**
- (1) *Damaged brackets.* Inspect the brackets (fig. 11) welded to the front of the vehicle for cracks or distortion. Install new brackets as required (pars. 11 and 12).
  - (2) *Distortion or damage to other linkages.* Refer to a above.

## 86. Emergency-Lift System

a. **MOLDBOARD FAILS TO MOVE.**

*Note.* Make certain that using organization personnel have taken all steps outlined in paragraph 59.

- (1) *Emergency-lift pump leaking oil.* Inspect the emergency-lift pump for external and internal oil leaks. External leaks can be caused by failure of either pump oil seal, of the plunger lever packing, or of the release valve packing (fig. 55). Internal leaks can be caused by failure of either lever plunger leather, or by excessive wear of the release valve. Remove pump (par. 71); overhaul it as required (pars. 104 to 106); then reinstall pump (par. 31).

(2) *Emergency-lift jack leaking oil.* Inspect the emergency-lift jack for external oil leaks. Leaks can be caused by failure of the packing assembly (fig. 58). Remove jack (par. 69) and adjust the gap between the bronze packing gland and the cylinder tube (par. 105) or install a new jack (par. 29), as required.

(3) *Damaged emergency-lift cable and/or sheaves.* If cable is damaged, install a new cable (par. 29). If sheaves are damaged, remove and install new parts as required (par. 70).

*b. MOLDBOARD FAILS TO RAISE UP HIGH ENOUGH FOR ENGAGEMENT OF THE CARRYING HOOKS.* Examine the emergency-lift cable for indications of stretching. Install a new cable if required (par. 29).

## **87. Carrying Hooks**

Carrying hooks fail to engage properly.

*Note.* Make certain that using organization personnel have performed all steps in paragraph 60.

Inspect the carrying hooks shaft (fig. 26) for distortion. If shaft is damaged, remove it and install a new one (par. 66).

## **Section III. MISCELLANEOUS REPAIR INSTRUCTIONS**

### **88. General**

Definite instructions cannot be furnished for the repairing of the structural parts of the equipment. These parts are heavy steel, and their repair will, of necessity, be determined by whatever damage each individual part may sustain, and by the availability of replacement parts. However, instructions contained in the following paragraphs may prove helpful in repairing damaged members.

### **89. Repairs**

*a. STRAIGHTENING.* The use of heat is not recommended when straightening the moldboard, lift link, push beams, tilt arms, push beam links, or any of the three piping guards. Heating weakens structural characteristics of the metals, and all straightening should be done cold whenever possible. Any part that is bent or buckled sufficiently to show strain or cracks after straightening must be reinforced or replaced.

*b. REINFORCEMENT.* No established rule can be made to cover the type of reinforcement to use for strengthening parts. Reinforcements can be made with angle or flat stock. It is imperative that the reinforcement extend over the whole length of the damaged area



of the part that has been straightened. The reinforcement stock to be used should be of the same tensile strength and thickness as the part that is being reinforced.

c. **WELDING.** The electric arc welding method is recommended for all installation and repair welding. Heat generated during welding is localized when an electric arc welder is used, and the burning of material is minimized. Additional advantages are that finished welds can be ground, filed, or drilled as necessary. The welding rod used must be substantially the same material as that used in the part being welded. For welding methods, refer to TM 9-2852.

## **Section IV. HYDRAULIC PUMP SUPPORT**

### **90. Description**

The hydraulic pump support (fig. 43) is a mounting base provided with a short horizontal shaft, mounted in bearings, at opposite sides of which the pump and driven pulley are mounted. There is an oil seal around this shaft on the driven pulley side. A line of nipples and elbows, with a pipe plug at top, provides means for oiling the shaft bearings.

### **91. Disassembly**

#### *a. Remove pump pulley driven shaft and bearings.*

- (1) Remove the shaft (fig. 43), taking it out at the pump side of the support. Shaft can be pressed out in a small arbor press, or can be knocked out with a plastic hammer or rawhide mallet.

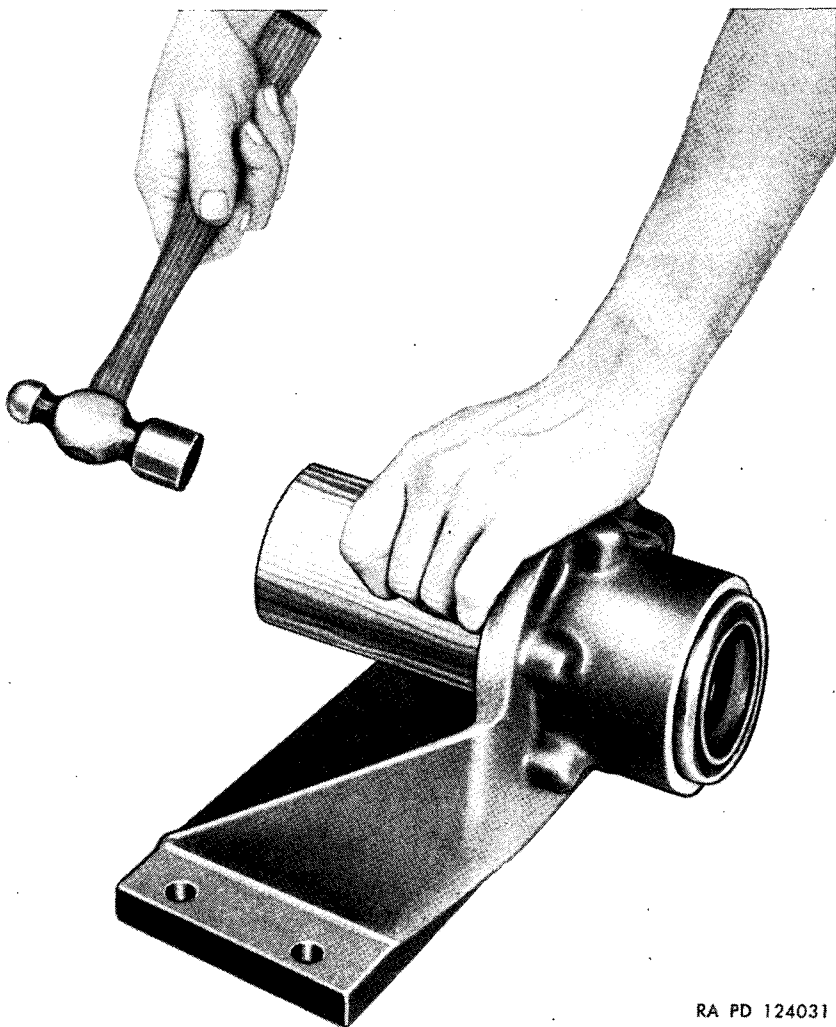
*Note.* Bearings remain on shaft.

**Caution:** Be careful not to damage threads at pulley end of shaft. If knocked out, partially install the castle nut on the end of the shaft to protect threads.

- (2) Remove the inner ball bearing lock nut and lock washer from the shaft.
- (3) Remove the inner ball bearing by tapping shaft end lightly with a plastic hammer or rawhide mallet.
- (4) Remove the outer ball bearing and the outer bearing sleeve by pressing them off together in a small arbor press.

#### *b. REMOVE OUTER OIL SEAL AND OIL FILLER LINE.*

- (1) Drive the oil seal (fig. 43) out at the pulley side of the support by tapping the seal from the pump side, using a wood block turned down to exactly fit the oil seal bore in the support (fig. 46).



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*Figure 46. Removing hydraulic pump support oil seal.*

- (2) Remove the pipe plug, elbow, nipple, and elbow which constitute the oil filler line.

## **92. Cleaning, Inspection, and Repair**

*a. CLEANING.* Wash all parts in volatile mineral spirits paint thinner, and dry them with filtered compressed air.

*b. INSPECTION AND REPAIR.* Examine the shaft, bearings, and oil seal for damage or wear (par. 116). All damaged or excessively worn parts must be replaced with new parts. Examine the support for cracks or distortion. Repairs (par. 89) can be made, but must not

deface the shaft bearing or oil seal journals, or the mounting pad for the pump.

### **93. Assembly**

#### *a.* **INSTALL OUTER OIL SEAL AND OIL FILLER LINE.**

- (1) Start the oil seal (fig. 43) into the bore in the support from the driven pulley side, keeping the lapped face of the seal toward the pump side. Drive the seal all the way into the bore, using a block of wood turned down to exactly fit the oil seal bore in the support.
- (2) Install the elbow, nipple, elbow and pipe plug which constitute the oil-filler line. Tighten all fittings and position the elbows so that the line turns toward the pump side of the support (to clear the driven pulley).

#### *b.* **INSTALL PUMP PULLEY DRIVEN SHAFT AND BEARINGS.**

- (1) Install the outer ball bearing (fig. 43) and the outer bearing sleeve on the driven pulley end of the shaft, using a small arbor press. Push bearing all the way onto the shaft, and push sleeve up against bearing.
- (2) Install the inner ball bearing on the pump end of the shaft, keeping the snap ring on the bearing at the outer (pump end) of the shaft. Tap bearing all the way onto the shaft with a plastic hammer or rawhide mallet.
- (3) Install the ball bearing lock washer and nut.
- (4) Install the shaft in the shaft-bore in the support, starting it from the pump side of the support. Drive it all the way in on a small arbor press, or by tapping the shaft end with a plastic hammer or rawhide mallet.

## **Section V. HYDRAULIC PUMP**

### **94. Description and Data**

*a.* **DESCRIPTION.** The hydraulic pump (fig. 20) is a gear-type pump that is driven by rotation of the vehicle propeller shaft. It consists of a housing with two covers (fig. 47), which enclose the two gears and two wear plates. The wear plates are installed in such a manner as to provide a self-compensating, oil-tight chamber in which the pumping action of the gears can take place. Spring-loaded check valves are installed in the two covers. Inlet and outlet ports are provided in the housing. Torque is applied to one (drive) gear only. This gear rotates the other (driven) gear. The drive shaft projects out of the adapter end cover, and there is an oil seal around this shaft to prevent loss of oil from the pump.

## **b. DATA.**

Make\_\_\_\_\_ Hydraulic Equipment Company  
Model\_\_\_\_\_ No 325  
Rating (at 1,200 rpm and 500 psi pressure)\_\_\_\_\_ 42 gpm

## **95. Disassembly**

*a. MARK HOUSING SECTIONS.* Using a prick punch, mark both sides of the pump housing (fig. 47) and the two covers so that these three parts can be assembled in their original positions.

### *b. REMOVE OPPOSITE ADAPTER END COVER.*

- (1) Turn the pump with the adapter end cover down and bolt it to the improvised plate (fig. 45).
- (2) Remove the nuts, washers, and 12 screws (fig. 47) which attach the two covers to the housing.
- (3) Lift off the cover.

*Note.* The wear plate at this end of the pump will remain on top of the gears, and the two check valve plungers and the two check valve plunger springs will fall out of the cover when it is removed.

- (4) Mark the wear plate with blue aniline dye to assure proper assembly, and lift it off of the gears.
- (5) Remove and discard the vellum gasket which separated the cover from the housing.

### *c. REMOVE GEARS AND SHAFTS.*

- (1) Mark the tops of the two gears and shafts (fig. 47) with blue aniline dye to assure proper assembly.
- (2) Simultaneously lift the two gears and their shafts out of the housing.
- (3) Lift the oil seal compression spring out of the drive shaft bore in the adapter end cover.

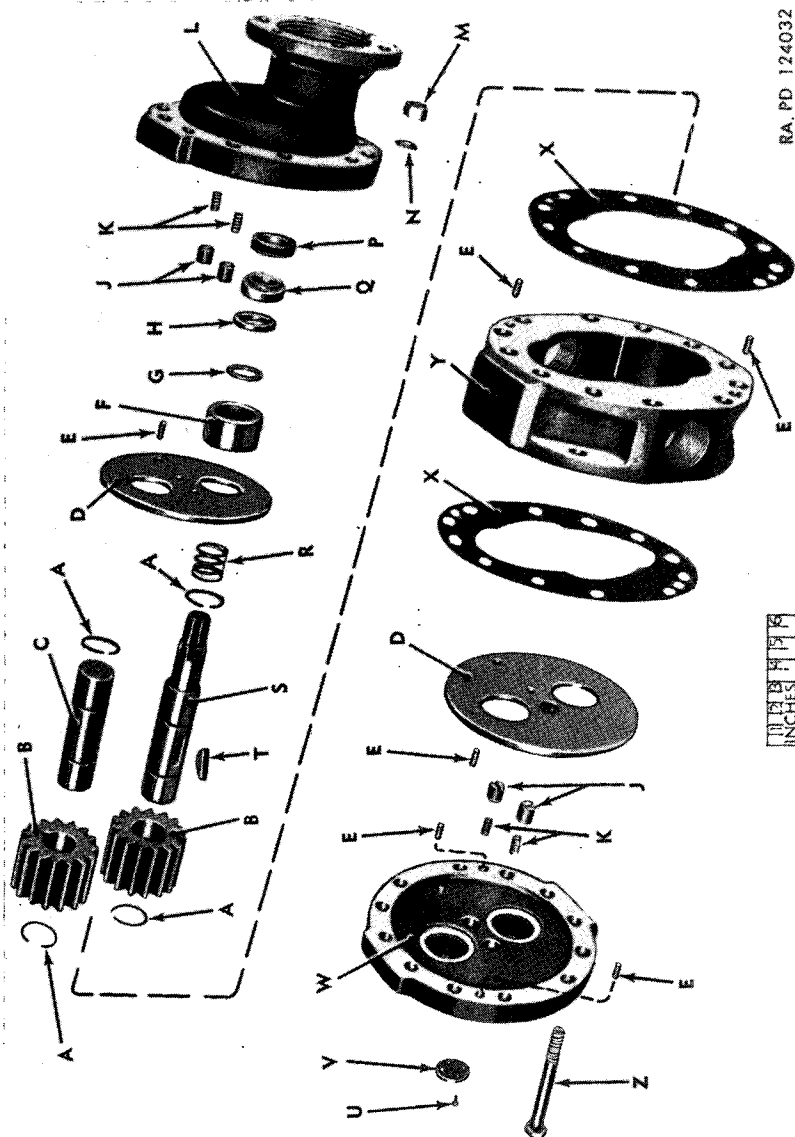
### *d. REMOVE HOUSING.*

- (1) Lift the housing straight up off of the adapter end cover.
- (2) Mark the wear plate (fig. 47) which remains on top of the adapter end cover with blue aniline dye to assure proper assembly.
- (3) Lift wear plate off of the adapter end cover.
- (4) Lift the two check valve plungers and two check valve plunger springs out of their bores in the adapter end cover.

### *e. REMOVE BEARINGS FROM COVERS.*

*Note.* There are two needle bearings in each cover. All four are removed as follows:

- (1) Start bearing up out of its bore, using the improvised wedge-type bearing remover (figs. 45 and 48).



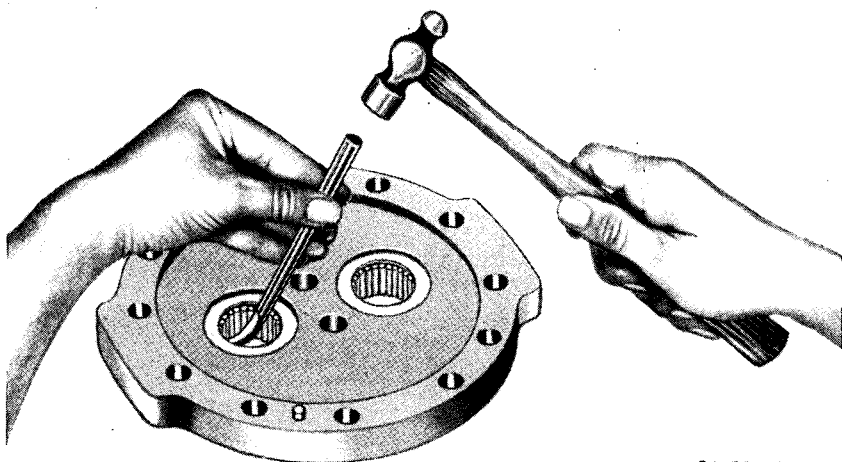
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INCHES

Figure 47. Hydraulic oil pump—exploded view.

Figure 47—Continued.

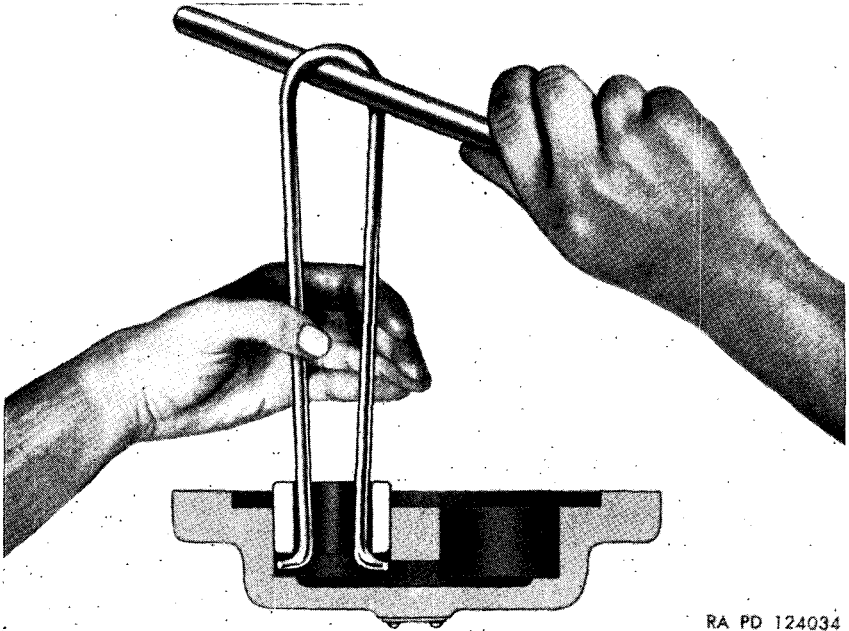
A—RING, SNAP—HDE-812X46  
B—GEAR—HDE-J30-6-25  
C—SHAFT, DRIVEN—HDE-L30-5-25  
D—PLATE, WEAR—HDE-J30-12  
E—DOWEL—HDE-A551X6  
F—BEARING, NEEDLE—HDE-A340X15  
G—RING, RETAINING, OIL SEAL—HDE-A408X47  
H—SEAL, OIL, DRIVE SHAFT—HDE-30-10RA  
J—PLUNGER, CHECK VALVE—HDE-513X11  
K—SPRING, CHECK VALVE PLUNGER—HDE-A501X29  
L—COVER, WITH INTEGRAL ADAPTER—HDE-9P30-2  
M—NUT—HDE-A238X5  
N—WASHER—HDE-A419X8  
P—SEAT, OIL SEAL—HDE-J30-11BK  
Q—RETAINER, OIL SEAL—HDE-30-10C  
R—SPRING, COMPRESSION, OIL SEAL—HDE-A501X159  
S—SHAFT, DRIVE—HDE-9P30-4-25  
T—KEY—HDE-A258X34  
U—SCREW—NO 39 (0.0995) X 0.114 X 3/16 LG—HDE-A386X10  
V—PLATE, NAME—HDE-A475X  
W—COVER—HDE-AM30-3  
X—GASKET, SHIM-TYPE—HDE-30-14  
Y—HOUSING, PUMP—HDE-30-1-25  
Z—SCREW—HDE-A439X11



RA PD 124033

Figure 48. Raising hydraulic pump bearing using improvised wedge-type bearing remover.

- (2) Remove bearing, using the improvised bearing puller (figs. 45 and 49).



RA PD 124034

*Figure 49. Removing hydraulic pump bearing using improvised bearing puller.*

*f. REMOVE OIL SEAL.*

- (1) Remove the adapter end cover from the improvised plate.
- (2) Invert the cover and tap outer end (now at top) with a plastic hammer or rawhide mallet. The oil seal retainer (fig. 47) will drop out.
- (3) Drive the oil seat out of the adapter end cover by using a block of wood (fig. 46) turned down to exactly fit the seat bore in the cover.
- (4) Lift the oil seal retaining ring and oil seal out of the oil seal retainer.

*g. REMOVE GEARS FROM SHAFTS.*

*Note.* Both gears (fig. 47) are "push" fits (par. 115) on their shafts.

- (1) Remove snap rings from each end of driven shaft, using snap-ring pliers.
- (2) Press gear off of driven shaft in a small arbor press.  
**Caution:** Do not hammer gear or shaft as even slight "scars" will destroy usefulness of these parts.
- (3) Remove snap rings and gear from drive shaft in same manner.

*Note.* This gear is keyed to its shaft.  
Lift key from slot in shaft.

## 96. Cleaning, Inspection, and Repair

*a. CLEANING.* Wash all parts in volatile mineral spirits paint thinner, and remove all gasket material that may remain on the housing, covers, or wear plates. Dry parts with filtered compressed air.

*b. INSPECTION AND REPAIR.* Examine the two gears, two shafts, two wear plates, four needle bearings, and the parts of the oil seal for damage or wear (par. 117). All damaged or excessively worn parts must be replaced with new parts. Remove any nicks or burrs which may be on the machined surfaces of the housing or covers. Break the edge of the shoulder in the adapter-end cover on which the seal seat rests, by using a scraper.

*Note.* Whenever either gear is excessively worn, it is generally advisable to replace both gears, instead of just the one, as these parts must be carefully mated to function properly.

## 97. Assembly

### *a. INSTALL GEARS ON SHAFTS.*

- (1) Place one snap ring (fig. 47) in the groove at one end of the drive shaft, using snap ring pliers.
- (2) Select the gear for the drive shaft in accordance with dye marks made during disassembly, and coat the gear bore with white lead pigment.
- (3) Press gear onto shaft with a small arbor press, inserting the key into the shaft slot and seating the gear properly on it. Press gear down to touch the snap ring.

**Caution:** Do not hammer gear or shaft as even slight "scars" will destroy usefulness of these parts.

- (4) Install snap ring at other end of shaft.
- (5) Install gear on driven shaft in same manner, except that there is no key between gear and shaft.

### *b. INSTALL OIL SEAL.*

- (1) Turn the adapter end cover with the small flange down and bolt it to the improvised plate (fig. 45).
- (2) Install a new oil seal seat (fig. 47) into the drive shaft bore of the adapter end cover. To install seat, position it at the top of the bore with the lapped surface of the seat at top, and align it carefully with the bore. Drive it into the bore using the improvised oil seal seat replacer (fig. 45). Drive it all the way down into the bore.
- (3) Insert a new oil seal into the oil seal retainer, and place the oil seal retaining ring on top of the seal inside the retainer.
- (4) Lower the retainer, open end up, into the drive shaft bore in the adapter end cover, and push it down onto the oil seat.



### c. INSTALL BEARINGS IN COVERS.

*Note.* There are two needle bearings (fig. 47) to be installed in each cover. All four are installed as follows:

- (1) Lubricate the bearing with instrument lubricating grease.
- (2) Place bearing at top of its bore and align it carefully with the bore.
- (3) Drive the bearing into its bore, using the improvised bearing replacer (fig. 45). Push it all the way into the bore.

### d. INSTALL GEARS AND HOUSING.

- (1) Lower the two check valve plunger springs (fig. 47) into the plunger bores in the adapter end cover.
- (2) Insert the two check valve plungers into their bores on top of the springs, with the slotted ends of the plungers on top.
- (3) Place the wear plate removed from this end on top of the adapter end cover.

*Note.* Wear plate can be identified and can be properly positioned by noting the dye marks made during disassembly.

Align the plate with the locating dowels in the cover, and press it down to compress the check valve plunger springs.

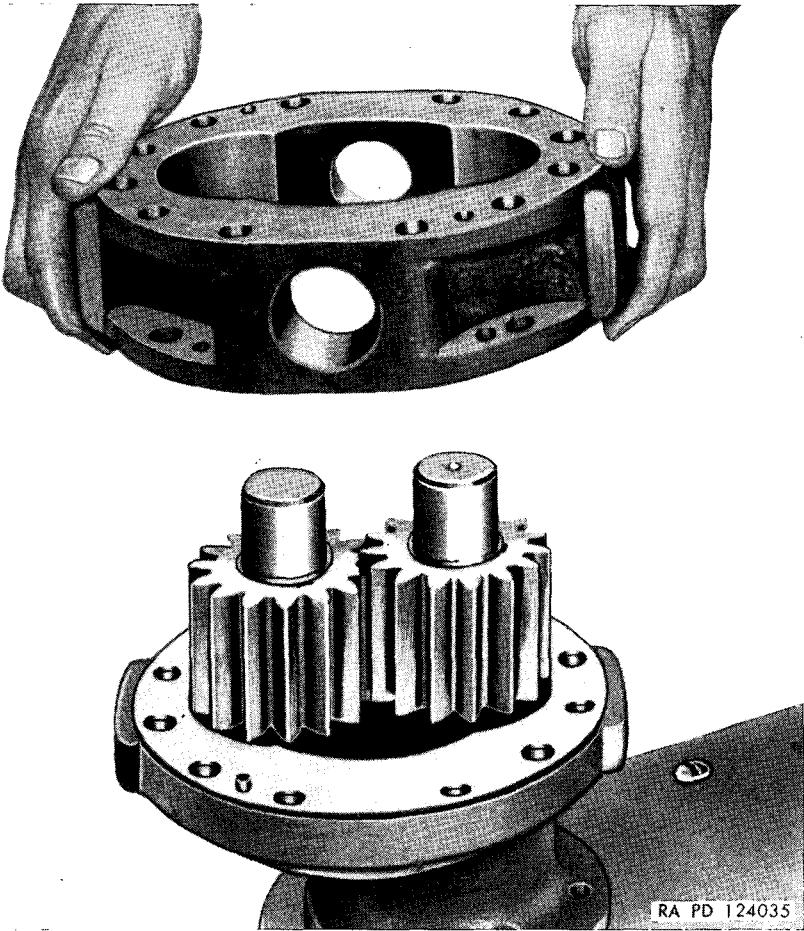
**Caution:** Make certain plungers properly enter their bores as the wear plate is lowered on top of them.

- (4) Lower the oil seal compression spring into the drive shaft bore in the adapter end cover.
- (5) Insert the drive shaft, splined end down, into the bore on top of the compression spring.
- (6) Position the two gears so that they will be mated in accordance with dye marks made during disassembly, and insert the driven shaft into its bore in the adapter end cover.
- (7) Place a new gasket on the machined surface of the adapter end cover.
- (8) Lower the housing onto the adapter end cover around the gears (fig. 50), positioning it in accordance with punch marks made during disassembly. Locate it over the dowel pins in the cover and seat it firmly on top of the gasket.

*Note.* The oil seal compression spring will cause the drive shaft to stand up approximately  $\frac{1}{2}$ -inch above the driven shaft. Shaft will go down into place when spring is compressed during installation of the opposite adapter end cover (e, below).

### e. INSTALL OPPOSITE ADAPTER END COVER.

- (1) Place a new gasket (fig. 47) on the machined surface of the housing.



*Figure 50. Installing hydraulic pump housing onto adapter end cover.*

- (2) Hold a straight edge diametrically across the top of the housing so that it touches the housing at each side of the driven gear and passes over the driven gear. Measure the clearance between the straight edge and driven gear with a feeler gage (fig. 51). This clearance should be 0.008 to 0.0010 inch.
- (3) Add or remove shim-type gaskets as required to obtain above clearance.
- (4) Place opposite adapter end cover on bench with inner side at top.
- (5) Lower the two check valve plunger springs (fig. 47) into the plunger bores in the cover.

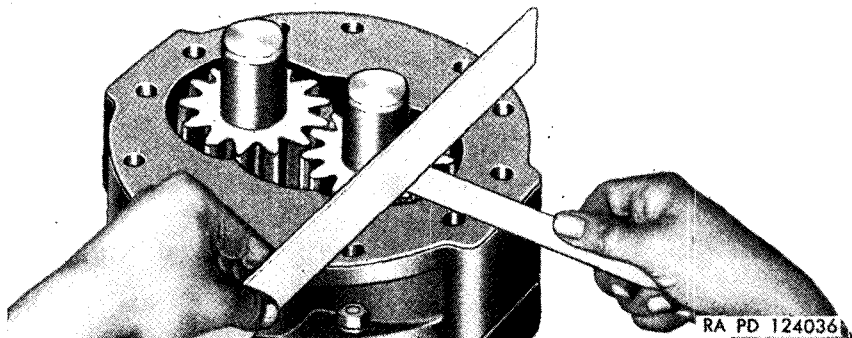


Figure 51. Measuring thickness of shim-type gasket under hydraulic pump cover.

- (6) Insert the two check valve plungers into the bores on top of the springs, with the slotted ends at top.
- (7) Place the remaining wear plate on top of the cover, alining it in accordance with dye marks made during disassembly.
- (8) Hold a straightedge across the cover to keep the wear plate in place, invert the cover, and lower it into position (fig. 52) on the housing. Locate it on housing in accordance with punch marks made during disassembly, slide the straightedge out of the way, and seat the dowel pins in the cover into their bores in the housing.

*Note.* Cover must be pushed down firmly to compress the oil seal compression spring. If the two gear shafts are correctly positioned, the cover bearings will slip easily down over the shafts as cover is lowered.

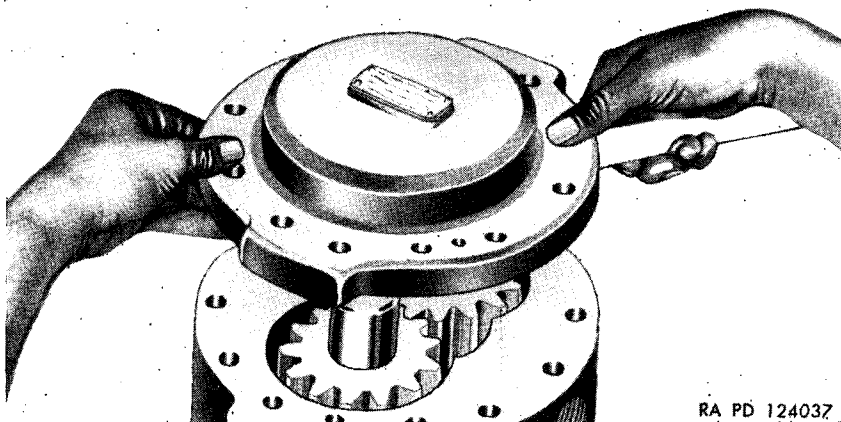
**Caution:** Do not force cover down if it is held up by the gear shafts. Jockey it until it goes down easily.

- (9) Install 4 of the 12 screws to secure covers to the housing, placing these in evenly spaced positions approximately 90° apart. Install washers and nuts and tighten nuts evenly with a torque wrench set at 90- to 110-ft-lb torque.
- (10) Rotate drive shaft. If too tight to rotate by hand, remove cover, install another shim-type gasket between cover and housing, and repeat steps (4) through (10).
- (11) Install remaining eight screws, washers and nuts. Tighten nuts with a torque wrench set at 90- to 100-ft-lb torque.

## 98. Test and Run-in

### a. PREPARATION FOR TEST.

- (1) Mount pump securely and provide a means for driving it at tachometer speeds (taken at pump drive shaft) of 200, 600, and 1,200 rpm.



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Figure 52. Installing hydraulic pump cover.

- (2) Provide a reservoir full of hydraulic oil (OH) and connect inlet side of pump to an intake pipe (or hose) arranged to draw oil from bottom of reservoir.
- (3) Connect outlet side of pump to an adjustable-pressure valve set to open at 1,000 psi pressure and having a by-pass with free discharge into the reservoir.

*Note.* A spare hydraulic pump control valve, properly adjusted, can be used. Connect outlet side of pump to opening in valve opposite the valve-stem head (fig. 54); install pipe plugs in all other ports except opening in bottom of valve; and mount valve on top of the oil reservoir with free discharge from bottom opening into reservoir.

- (4) Provide a thermometer for testing temperature of oil in reservoir.

#### b. TEST AND RUN-IN.

- (1) Open valve so that pump discharge will flow freely into reservoir.

*Note.* If hydraulic-pump control valve is used, position the valve stem head at "spot" located by "feeling" the detent position inside the valve (this is the HOLD position of the operating lever (par. 43) when valve is installed in the vehicle).

- (2) Operate pump at 200 rpm for 10 minutes or longer if necessary to raise hydraulic oil temperature to approximately 90° F.
- (3) Close valve so that pump operates against valve pressure setting.

*Note.* If control valve is used, rotate valve stem head counterclockwise to the (internal) stop at end of valve stem head movement.

- (4) Allow pump to build up enough pressure (1,000 psi) to open the valve, and to run against this pressure for approximately 10 seconds.

- (5) Open valve for 5 seconds, then repeat (3) and (4) above.
- (6) Continue to open and close valve in above manner for 2 or 3 minutes. Watch for possible "freeze-up" of pump (to be detected by increase of load on the drive and by "screeching" of the pump). Stop test and overhaul pump if it "freezes."
- (7) Increase drive speed to 600 rpm and repeat (3) through (6) above.
- (8) Increase drive speed to 1,200 rpm and repeat (3) through (6) above. Continue (6) above until hydraulic oil temperature is raised to 160° F.
- (9) End test and certify pump for installation in the vehicle.

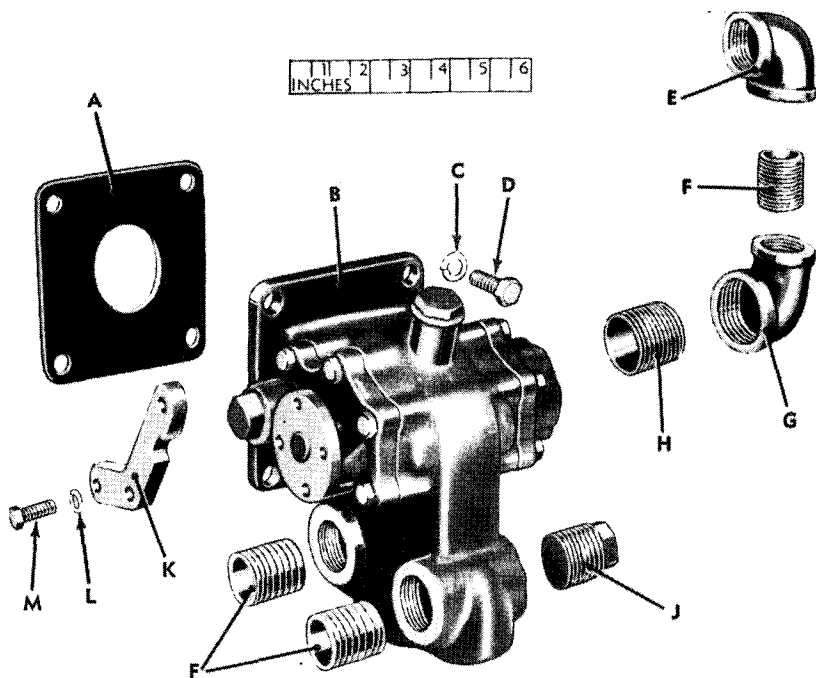
## Section VI. CONTROL VALVE

### 99. Description and Data

*a.* **DESCRIPTION.** The control valve is a four-position valve used to obtain these following conditions of operation: "DOWN"—when in this position it directs the flow of hydraulic oil, under pressure from the hydraulic pump, into the upper ports of the two hydraulic cylinders, to force the cylinder rams down; "RAISE"—when in this position it reverses the flow of hydraulic oil to the cylinders, to force the cylinder rams up; "HOLD"—when in this position it "locks" hydraulic oil in the cylinder lines so that the cylinder rams cannot move, and bypasses the flow of oil from the pump into the oil reservoir; "FLOAT"—when in this position it opens a small bypass between the two lines to the cylinders, so that the cylinder rams can be moved slowly in either direction by an external force, and also bypasses the flow of oil from the pump into the oil reservoir. This valve consists of a body (figs. 53 and 54) with a head (cap) at each end. It contains threaded ports for connection of the hydraulic lines, a four-position rotor, an adjustable relief valve, a pusher-operated two-stage check valve (operated by a cam face on the rotor), and a spring-loaded plunger roller which "locates" the four rotor positions by settling into cam detents on the side of the rotor. "Locating" of the rotor is accomplished by feeling the deepest detent, which coincides with the "HOLD" position. The valve is mounted upon the oil reservoir, and there is a bottom opening through which the relief valve discharges oil bypassed from the pump.

*b.* **DATA.**

Make----- Ordnance manufactured item  
 Relief valve setting (releases at this pressure)----- 1,000 psi



A — GASKET, CONTROL-VALVE-TO-HYDRAULIC-PUMP RESERVOIR — 7323404

B — VALVE, CONTROL, HYDRAULIC PUMP — 7323406

C — WASHER, LOCK —  $\frac{1}{2}$ -IN — 120384

D — BOLT —  $\frac{1}{2}$ -20NF-2 X 1 — 223704

E — ELBOW, PIPE, STRAIGHT — 90-DEG 1 — 119100

F — NIPPLE, PIPE — 1 X  $1\frac{1}{2}$  — 127874

G — ELBOW, PIPE, REDUCING — 90-DEG  $1\frac{1}{4}$  X 1 — 192652

H — NIPPLE, PIPE —  $1\frac{1}{4}$  X  $1\frac{3}{8}$  — 144616

J — PLUG, PIPE — 1-IN — 113187

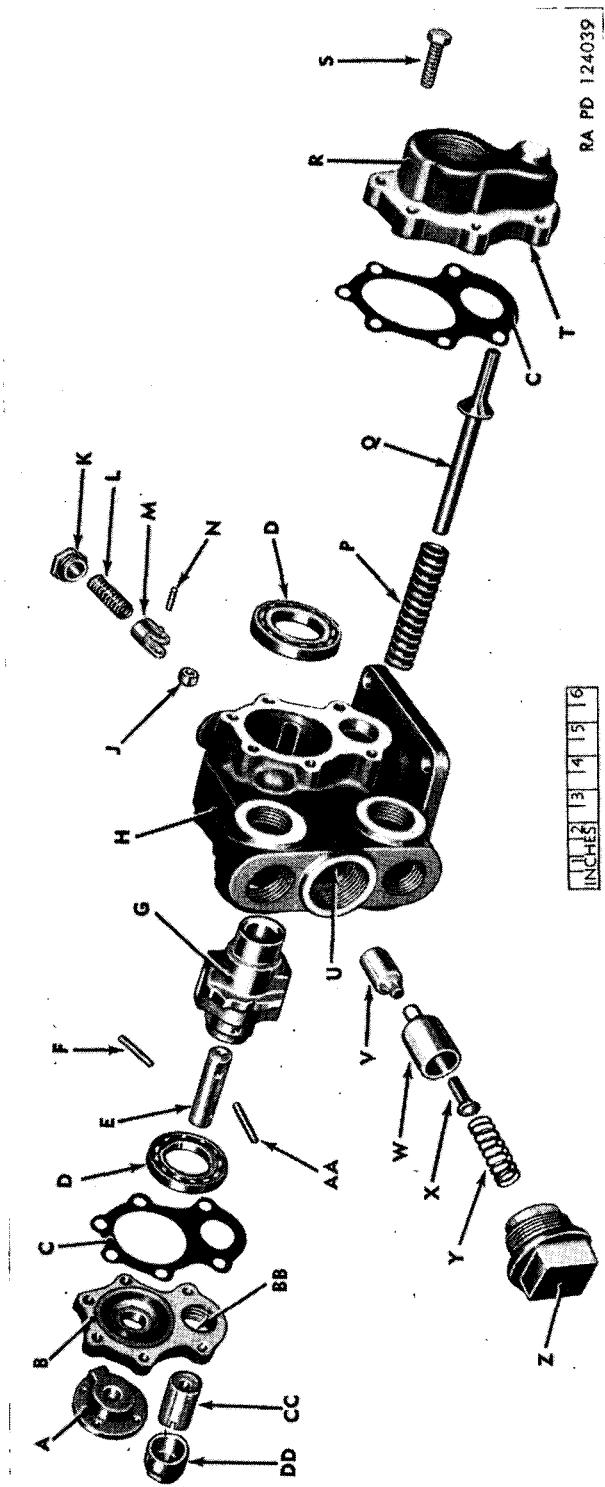
K — LINK, CONTROL-ROD-TO-VALVE-STEM-HEAD — 7323847

L — WASHER, LOCK —  $\frac{3}{8}$ -IN — 120382

M — BOLT —  $\frac{3}{8}$ -16NC-2 X 1 — 227796

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*Figure 53. Control valve and hydraulic lines.*



RA PD 124039

Figure 54. Control valve—exploded view.

A—HEAD, VALVE STEM—7323528  
B—SEAL, OIL—500226  
C—GASKET (FIBRE) (CAM STOP HEAD TO VALVE BODY (1), INLET HEAD TO VALVE BODY (1))—7323526  
D—BEARING, BALL—700072  
E—SHAFT, ROTOR—7323507  
F—PIN, TAPER—103616  
G—ROTOR—7323509  
H—BODY—7323506  
J—ROLLER, CAM—7323530  
K—CAP, CAM ROLLER PLUNGER—7323508  
L—SPRING, CAM ROLLER PLUNGER—7323536  
M—PLUNGER, CAM ROLLER—7323527  
N—PIN, CAM ROLLER—7323529  
P—SPRING, RELIEF VALVE—7323535  
Q—VALVE, RELIEF—7323514  
R—HEAD, INLET—7323532  
S—SCREW— $\frac{3}{8}$ -16NC-3X1 $\frac{1}{8}$ —180123  
T—SEAT, RELIEF VALVE—7323516  
U—SEAT, OUTER, CHECK VALVE—7323524  
V—PUSHER, CHECK VALVE—7323523  
W—VALVE, CHECK, OUTER—7323511  
X—VALVE, CHECK, INNER—7323515  
Y—SPRING, PUSHER, CHECK VALVE—7323537  
Z—CAP, CHECK VALVE—7323525  
AA—PIN, TAPER—103617  
BB—HEAD, CAM STOP—7323531  
CC—SCREW, ADJUSTING, RELIEF VALVE—7323513  
DD—CAP, CAM STOP HEAD—7323512

## 100. Disassembly

*Note.* Ordinarily, it is not necessary to remove any of the pipe fittings when overhauling the valve, as these will not interfere with access to the interior.

### a. REMOVE PIPE FITTINGS AND CONTROL ROD TO VALVE STEM HEAD LINK.

- (1) Remove the 90° pipe elbow (fig. 53), pipe nipple, 90° reducing pipe elbow, and pipe nipple from the inlet port of the valve.
- (2) Remove the two pipe nipples from the outlet ports.
- (3) Mark the control rod to valve stem head link position with a prick punch so that it can be installed in the original position.
- (4) Remove the two bolts and lock washers and remove the link.
- (5) Remove the four pipe plugs from the unused ports.

### b. REMOVE CAM STOP HEAD.

- (1) Drive out the taper pin (fig. 54) which secures the valve stem head to the rotor shaft, and remove the valve stem head.



- (2) Remove the relief valve adjusting screw cover cap, and screw out the relief valve adjusting screw.
  - (3) Remove the six cap screws which secure the cam stop head to the valve body.
  - (4) Remove the head and the gasket.
  - (5) Turn the valve body to place the side which is now open down, and tap out the rotor assembly, with the ball bearing at the bottom end still on the rotor. Use a block of wood turned down to fit the port opening in the inlet head.
- c. REMOVE INLET HEAD.*
- (1) Remove the six cap screws (fig. 54) which secure the inlet head to the valve body.
  - (2) Remove the inlet head and the gasket.
  - (3) Turn the valve body to place the inlet head side down, and drop out the relief valve and relief valve spring.
  - (4) With the valve body still in this position, tap out the remaining ball bearing, using a block of wood turned down to fit the rotor bore in the body.
- d. REMOVE CHECK VALVES.*
- (1) Remove the check valve cap (fig. 54).
  - (2) Turn the valve body to place the cap opening down, and drop out the check valve pusher spring, the inner check valve, the outer check valve, and the check valve pusher.
- e. REMOVE CAM PLUNGER ROLLER.*
- (1) Remove the cam plunger roller cap (fig. 54).
  - (2) Turn the valve body to place the cap opening down and drop out the cam plunger roller spring and the cam roller plunger, with the cam plunger roller attached.
  - (3) Drive the cam plunger roller pin out of the plunger and remove the cam plunger roller from the plunger.
- f. DISASSEMBLE ROTOR ASSEMBLY.*
- (1) Remove the ball bearing from the rotor (fig. 54), using a small arbor press.
  - (2) Drive out the taper pin and separate the rotor shaft from the rotor.

## 101. Cleaning, Inspection, and Repair

*a. CLEANING.* Wash all parts thoroughly with volatile mineral spirits paint thinner, and dry them with filtered compressed air.

*b. INSPECTION.* Check all critical dimensions (par. 118) and replace any parts that are excessively worn or damaged. Inspect housing parts for cracks or damage to machined surfaces and threaded ports, and replace any parts that are damaged. Inspect all three

springs. Each should stand erect when placed on end and should meet the free-length requirement (par. 118). Replace springs which do not meet these requirements.

**c. REPAIR.** Using a valve grinder and a fine valve grinding compound, reseal the relief valve in the relief valve seat (inside the inlet head). Reseat the outer check valve in the check valve seat located inside the valve body. Reseat the inner check valve in the inner check valve seat inside the check valve. Wash out all valve grinding compound residue with volatile-mineral-spirits paint thinner and dry parts with filtered compressed air.

## **102. Assembly**

**a. GENERAL.** Carefully clean all parts prior to assembly to make certain that they are free from abrasives and foreign material of any kind.

### **b. INSTALL INLET HEAD.**

- (1) Push one ball bearing (fig. 54) into the inlet head side of the rotor bore in the valve body, using a small arbor press. Seat the bearing firmly against the shoulder in the body.
- (2) Drop the relief valve spring and the relief valve into the relief valve bore in the valve body, inserting these parts from the inlet-head side of the body.
- (3) Place a new gasket over the machined surface at the inlet head side of the valve body.
- (4) Position the inlet head over the gasket, and secure it in place with six cap screws.

### **c. INSTALL ROTOR.**

- (1) Install the remaining ball bearing on the rotor (fig. 54), using a small arbor press. Push it all the way on.
- (2) Insert the rotor shaft into the end of the rotor, and install the taper pin to hold the shaft in place.
- (3) Hold the rotor assembly so that the shaft end is toward the cam-stop head, and rotate it so that the cam face (on the side of the rotor) which has three distinct detent positions (these detents are curved to match the small-diameter contour of the cam plunger roller) will be facing that side of the valve body which holds the cam plunger roller.
- (4) Insert the rotor assembly into the valve body, fitting the inlet-head end of the rotor into the bearing already installed in the body. Tap the assembly into the valve body, using a plastic hammer or rawhide mallet, until the bearing on the rotor is firmly seated.
- (5) Without rotating the rotor, place a new gasket over the machined surface of the valve body, position the cam stop

head over gasket, and secure the head in place with six cap screws.

- (6) Still without rotating the rotor, install the valve stem head over the end of the rotor shaft, positioning this head so that it can be secured in place with the taper pin.
- (7) Install the taper pin.

*Note.* If original parts are installed, the taper pins will make it impossible to position the rotor incorrectly with respect to the valve stem head. When new parts are installed, the taper pin bores must be reamed for installation of the taper pins, and care must be exercised not to turn the rotor 180° with respect to the valve stem head. Any movement of the rotor assembly during assembly will result in improper installation.

*d.* INSTALL CHECK VALVES.

- (1) Insert the check valve pusher (fig. 54), small diameter end first, into the check valve bore of the valve body.
- (2) Place the inner check valve inside the outer check valve and seat it properly.
- (3) Insert the outer check valve, small diameter end first, into the valve body bore, on the top of the pusher.
- (4) Place the check valve pusher spring on top of the inner check valve head (inside the outer check valve).
- (5) Install the check valve cap.

*e.* INSTALL CAM PLUNGER ROLLER.

- (1) Place the cam plunger roller (fig. 54) between the bosses of the cam roller plunger.
- (2) Install the cam plunger roller pin.
- (3) Drop the plunger and roller, roller end first, into the cam plunger roller bore of the valve body.
- (4) Drop the cam roller plunger spring into the bore.
- (5) Install the cam roller plunger cap.

*f.* ADJUST THE RELIEF VALVE.

- (1) Screw the relief valve adjusting screw (fig. 54) into the cam stop head side of the relief valve bore in the valve body.
- (2) Adjust the screw to obtain a relief valve pressure setting of 1,000 psi.

*Note.* If bench equipment for adjusting the relief valve is not available, adjustment can be made while the control valve is installed in the vehicle by setting the relief valve so that it will not open when the control valve is at "RAISE" and the moldboard is being raised; but so that it will open immediately after the moldboard has reached its extreme raised position.

- (3) Install the relief valve adjusting screw cover cap.

**g. INSTALL CONTROL ROD TO VALVE STEM HEAD LINK AND PIPE CONNECTIONS.**

- (1) Noting the marks made during disassembly, relocate the control rod to valve stem head link (fig. 53) on the valve stem head, and secure it in place with two bolts and lock washers.
- (2) Install two pipe nipples in the threaded ports at the valve stem head side of the valve.
- (3) Install four pipe plugs in the remaining ports at the projecting front side of the valve.
- (4) Install the pipe nipple, 90° reducing pipe elbow, a second pipe nipple, and a 90° pipe elbow in the inlet port (opposite the valve stem head). In tightening these fittings position the elbows as shown in figure 20.

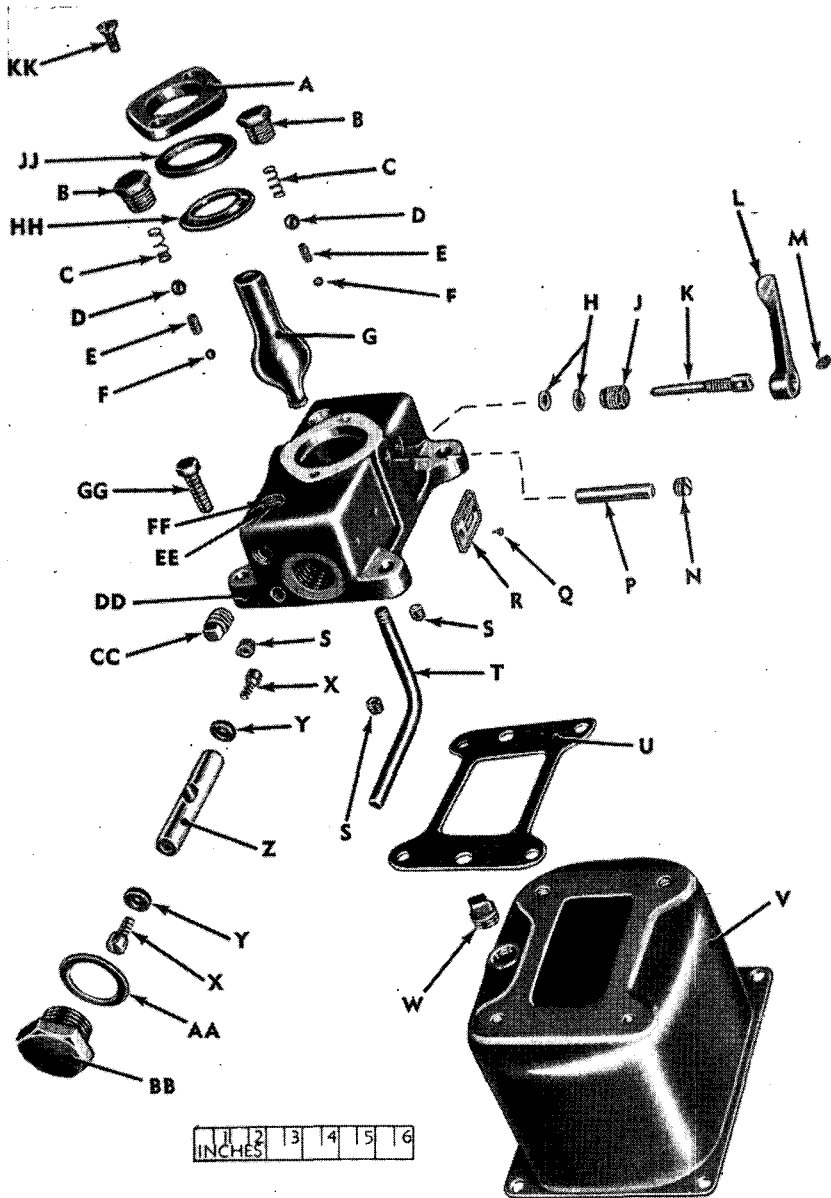
## **Section VII. EMERGENCY-LIFT HAND-OPERATED PUMP**

### **103. Description and Data**

*a. DESCRIPTION.* The emergency-lift pump is a lever-operated hydraulic oil pump (fig. 55) mounted on top of a small oil reservoir. Reciprocal operation of the operating lever moves the plunger back and forth in a horizontal bore (cylinder) in the pump housing. The lever is supported by a ball-and-socket-type mounting in the top of the pump housing. Plunger action draws oil from the reservoir beneath the pump through an inlet pipe, and expels the oil through an outlet at the front of the pump housing. Spring-loaded ball-type check valves keep the oil flowing in one direction as a result of plunger movement, and permit building up a hydraulic pressure at the outlet side. A release valve with an external lever can be manually opened to permit oil on the outlet side to flow back into the reservoir. No pressure can be built up on the outlet side when this release valve is open. An oil filler plug at the top of the reservoir provides means for filling the reservoir with oil.

*b. DATA.*

Make_____	Commercial Shearing and Stamping Company
Model_____	P301
Pump displacement per piston stroke_____	2,485 cu. in.
Pressure developed (with 50 lb. force on operating lever)_____	3,200 psi
Reservoir capacity (approximate)_____	1 gal.



RA:PD 124040

Figure 55. Emergency-life hand-operated pump and reservoir—exploded view.

Figure 55—Continued.

A—RETAINER, PLUNGER OPERATING LEVER PACKING, HAND-OPERATED PUMP—7097402  
B—RETAINER, SPRING, OUTLET CHECK VALVE—7520845  
C—SPRING, COMPRESSION—7097391  
D—BALL, OUTLET CHECK VALVE— $\frac{3}{8}$ -IN—145633  
E—SPRING, INLET, CHECK VALVE—7097393  
F—BALL, INLET CHECK VALVE— $\frac{1}{4}$ -IN—145629  
G—LEVER, OPERATING, HAND-OPERATED PUMP—7705126  
H—PACKING, RELEASE VALVE—7520844  
J—NUT, RELEASE VALVE, PACKING—CSS-E1011  
K—VALVE, RELEASE—7520847  
L—LEVER, OPERATING, RELEASE VALVE—7089473  
M—SCREW— $\frac{1}{4}$ -20NC-3 X  $\frac{3}{8}$ —191956  
N—PLUG, PIPE— $\frac{1}{4}$ -IN—103884  
P—PIN, PLUNGER-OPERATING LEVER—7097394  
Q—SCREW, SELF-TAPPING—NO 4-40 X  $\frac{1}{4}$ —CSS-XS8-1  
R—PLATE, NAME—CSS-A2078-6  
S—PLUG, PIPE— $\frac{1}{8}$ -IN—189566  
T—PIPE, INLET—7520849  
U—GASKET, PUMP HOUSING TO OIL RESERVOIR—7520846  
V—RESERVOIR, OIL—7520848  
W—PLUG, FILLER, RESERVOIR—7520869  
X—SCREW, RETAINING, OIL SEAL PLUNGER—7097397  
Y—SEAL, OIL PLUNGER—7089405  
Z—PLUNGER—7089422  
AA—GASKET, PLUNGER CAP—7097392  
BB—CAP, PLUNGER—7097395  
CC—PLUG, PIPE— $\frac{1}{4}$ -IN—CSS-X1-11  
DD—HOUSING, HAND-OPERATED PUMP—CSS-N1005-0.562  
EE—SEAT, INLET CHECK VALVE—7089418  
FF—SEAT, OUTLET CHECK VALVE—7089419  
GG—SCREW— $\frac{3}{8}$  X  $1\frac{1}{4}$ -IN—CSS-X2-9  
HH—PACKING, PLUNGER—7097398  
JJ—RING, FILLER, PLUNGER PACKING—7089406  
KK—SCREW— $\frac{1}{4}$ -20NC-2 X  $\frac{5}{8}$ —120655

## 104. Disassembly

*Note.* The pump can be removed from the reservoir without removing the reservoir from the vehicle.

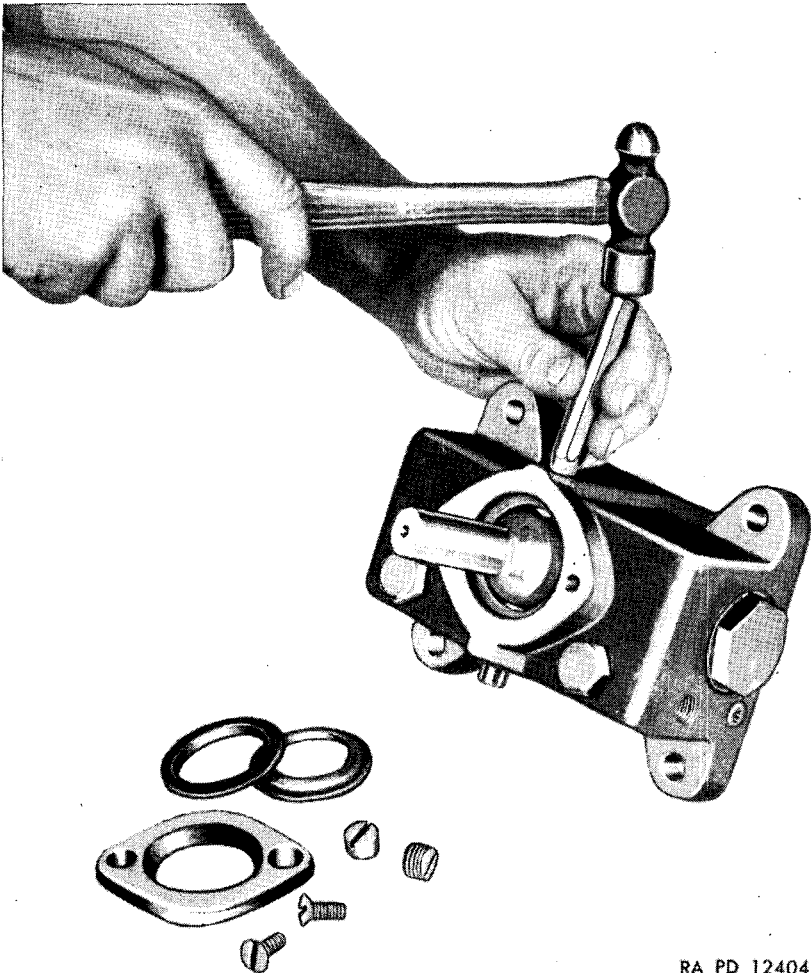
### a. REMOVE PUMP FROM RESERVOIR.

- (1) Remove the four cap screws (fig. 55) which attach the pump housing to the oil reservoir, and lift the pump from the reservoir.
- (2) Remove the gasket from the top of the reservoir.

### b. REMOVE OPERATING LEVER AND INLET PIPE.

- (1) Unscrew the inlet pipe (fig. 55) and remove the pipe from the bottom of the pump housing.

- (2) Remove the split cotter pin and the pin which secures the operating lever to the plunger-operating lever, and remove the operating lever.
  - (3) Remove the hand-control knob from the operating lever.
- c. REMOVE PLUNGER-OPERATING LEVER.
- (1) Remove the two screws (fig. 55) and the plunger packing retainer.
  - (2) Lift out the packing filler ring, and the plunger packing.
  - (3) Remove the two pipe plugs that enclose the ends of the plunger-operating lever pin.
  - (4) Drive out the pin with a pin punch (fig. 56).



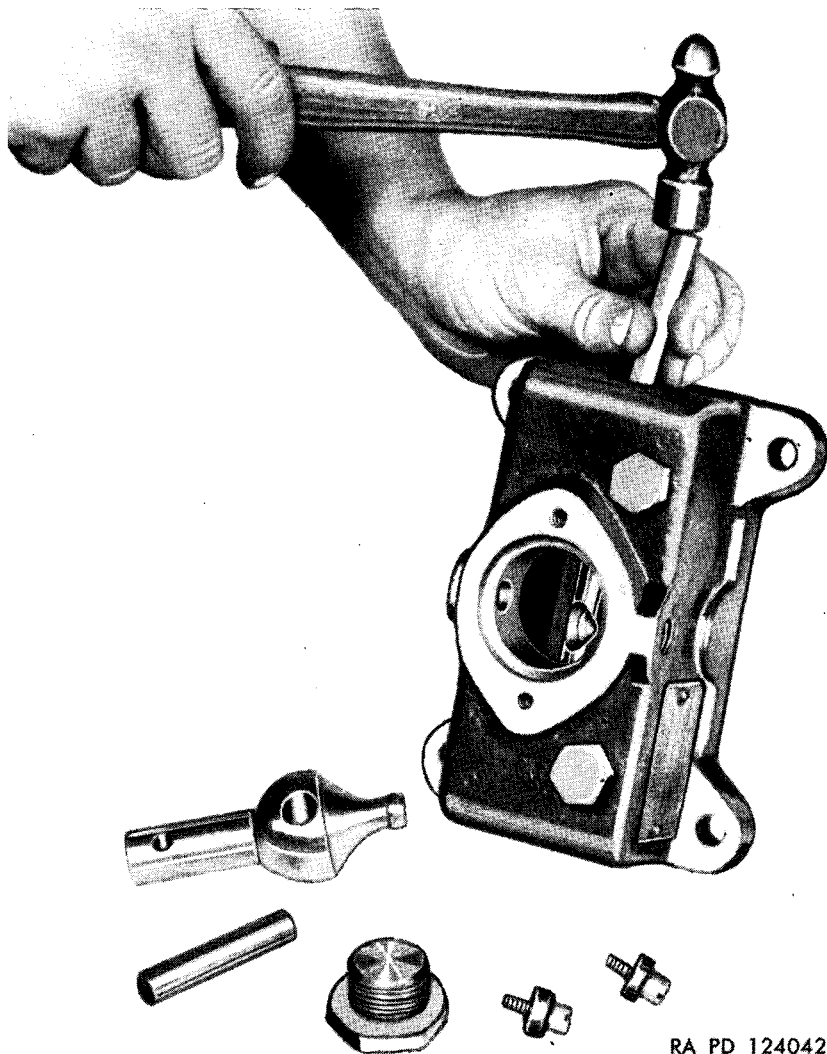
RA PD 124041

*Figure 56. Removing hand-operated pump lever pin.*

(5) Lift the plunger-operating lever out of the housing.

*d. REMOVE PLUNGER.*

- (1) Remove the plunger cap and gasket (fig. 55) from the back end of the pump housing.
- (2) Remove the two lever plunger screws (one at each end of plunger) together with the lever plunger seals.
- (3) Drive the plunger out of the bore in the housing with a pin punch (fig. 57).



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*Figure 57. Removing hand-operated pump plunger.*



*e.* **REMOVE VALVES.**

- (1) Remove the two outlet check valve spring retainers (fig. 55).
- (2) Invert the housing and drop out the two outlet check valve springs, and two outlet check valve balls, the two inlet check valve springs, and the two inlet check valve balls.
- (3) Remove the screw that secures the release valve lever and remove lever.
- (4) Remove the release valve and the release valve packing nut.
- (5) Pry out the two release valve packings.

## **105. Cleaning, Inspection, and Repair**

*a.* **CLEANING.** Clean all parts thoroughly with volatile-mineral-spirits paint thinner and dry them with filtered compressed air.

*b.* **INSPECTION AND REPAIR.** Check all critical dimensions (par. 119) and replace any parts which are worn. Inspect the housing carefully for obvious damage, and particularly inspect the plunger, plunger bore, the seats of the release valve and the four check valves, and the valves for scratches. Regrind the valve seats, if necessary, using a fine valve-grinding compound.

## **106. Assembly**

*a.* **INSTALL PLUNGER.**

- (1) Insert the plunger (fig. 55) into the plunger bore of the pump housing, positioning it so that the detent for the plunger-operating lever is at top and approximately centered in the plunger-operating-lever bore.
- (2) Install two new lever plunger seals by securing these to the respective ends of the plunger with the lever plunger screws.
- (3) At the end of the pump housing which is to be the rear end (the release valve lever is on the right side), install a new plunger gasket and the plunger cap.

*b.* **INSTALL PLUNGER-OPERATING LEVER.**

- (1) Insert the plunger-operating lever (fig. 55) into its bore in the pump housing with the small rounded end engaged in the detent of the plunger.
- (2) Position the lever with the plunger-operating lever pin bore in the lever crosswise in the housing to aline it with the pin bores in the housing.
- (3) Insert the plunger-operating lever pin so that it engages the lever and holds it into the housing.
- (4) Install the pipe plugs at each end of this pin.

- (5) Place a new plunger lever packing over the lever and push it down around the ball portion of the lever inside the housing.
  - (6) Place a new plunger lever packing filler ring on top of the packing.
  - (7) Position the plunger-operating lever packing retainer onto the top of the housing around the lever.
  - (8) Secure the retainer in place with two screws.
- c. **INSTALL VALVES.**
- (1) Into each of the two bores at the top of the housing (one on each side of the plunger-operating lever) drop the  $\frac{1}{4}$ -inch inlet check valve ball, the inlet check valve spring, the  $\frac{3}{8}$ -inch outlet check valve ball, and the outlet check valve spring (fig. 55).
  - (2) Install the two outlet check valve spring retainers.
  - (3) Insert two new release valve packings into the release valve bore on the right side of the housing.
  - (4) Install the release valve packing nut, turning it down tight against the packing.
  - (5) Install the release valve, turning it down until it seats.
  - (6) Position the release valve lever on the end of the valve so that it projects upward, and secure it in place with a screw.
- d. **INSTALL INLET PIPE AND PUMP-OPERATING LEVER.**
- (1) Screw the inlet pipe (fig. 55) into its bore in the bottom of the pump housing.
  - (2) Place the sleeve at the bottom of the operating lever over the top of the plunger-operating lever, and secure it in place with the pin and split cotter pin.
  - (3) Install the hand-control knob on the operating lever.
- e. **INSTALL PUMP ON RESERVOIR.**
- (1) Place a new oil reservoir to housing gasket on top of the reservoir (fig. 55).
  - (2) Install the pump on top of the gasket and secure it with the four cap screws.

*Note.* If reservoir has not been removed from the vehicle, complete the pump installation by installing the hose (fig. 30) which connects the pump to the emergency-lift jack.

## **Section VIII. EMERGENCY-LIFT HYDRAULIC JACK**

### **107. Description and Data**

a. **DESCRIPTION.** A single-acting emergency-lift hydraulic jack (fig. 58), designed to extend a plunger when under hydraulic pressure, is used on the bulldozer. Return of the plunger to the starting position

is effected by the weight of the load on the plunger, when the release valve (fig. 30) on the pump is opened to release hydraulic oil from the jack. A cable sheave support is welded to the lower end of the jack plunger.

b. DATA.

Make----- Hydraulic Equipment Company  
Model----- No. 28-S30BBA-12  
Type----- single acting  
Piston diameter----- 4 in.  
Piston stroke----- 12 in.

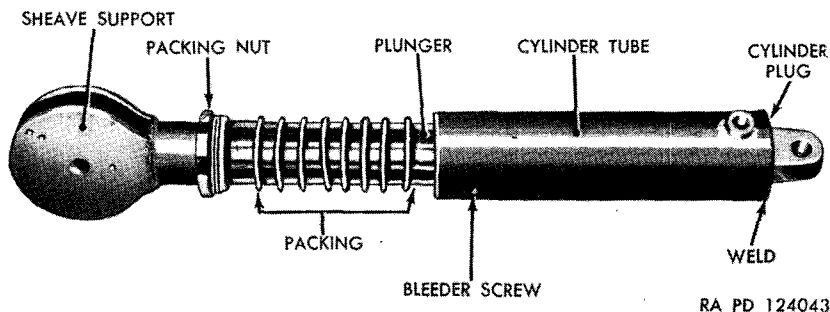


Figure 58. Emergency-lift hydraulic jack.

## 108. Disassembly

*Note.* Under ordinary circumstances, it is preferable to replace the jack rather than attempt disassembly and replacement of parts, as the plug at the top of the cylinder is welded into the cylinder tube, and the sheave support at the end of the plunger is welded on. Should it be necessary, however, to make repairs (such as replacing the packing), disassembly can be effected as follows:

a. REMOVE PACKING.

- (1) Cut the sheave support away from the end of the plunger.
- (2) Grind the end of the plunger to a smooth cylindrical contour.
- (3) Screw the packing nut (fig. 58) out of the cylinder tube and remove it over the end of the plunger.
- (4) Remove the packing from around the plunger.
- (5) Remove the wiper ring, which is inside the outer end of the packing nut.

b. REMOVE PLUNGER.

- (1) Place the cylinder tube in a metal lathe, carefully centering it on the lathe centers.
- (2) Turn down the weld between the cylinder plug and the cylinder tube.

*Note.* This weld is approximately one-fourth inch deep. Remove only the weld (until plug is free) and the plug can be used again.

- (3) Pull the plunger (with integral piston) out through the plug end of the cylinder tube.

## 109. Cleaning, Inspection, and Repair

*a. CLEANING.* Wipe off all parts thoroughly with volatile mineral spirits paint thinner and dry them with filtered compressed air.

*b. INSPECTION AND REPAIR.* If the jack is leaking (such a leak will occur around the plunger), pull the plunger out of the jack as far as possible (fig. 58) and examine the plunger surface for nicks and scratches. If leakage is caused by shallow scratches on the surface of the plunger, repair can sometimes be effected by resurfacing the plunger, using a strip of dry, medium abrasive cloth to polish the surface. Leaks can also be corrected by tightening the packing nut until the nut seats firmly against the end of the tube (when shipped from the factory, there is a  $\frac{1}{16}$ - to  $\frac{3}{32}$ -inch gap left between the nut and the end of the cylinder tube for purposes of adjustment).

## 110. Assembly

### *a. INSTALL PLUNGER.*

- (1) Insert plunger (piston end last) into the cylinder plug end of the cylinder tube, and pull it through so that the plunger projects out the other end of the tube.
- (2) Place the cylinder plug in the (top) end of the cylinder tube positioning it so that the center line of the bore through the plug top is approximately parallel to the center line of the threaded bore in the cylinder tube at this end.
- (3) Weld the plug to the tube with a  $\frac{1}{4}$ -inch deep weld all around.

### *b. INSTALL SHEAVE SUPPORT.*

- (1) Install light new packing rings over the plunger, and push these down into the end of the cylinder tube.
- (2) Install a new wiper ring inside the groove at the outer end of the packing nut.
- (3) Install the packing nut over the plunger and screw it down into the cylinder-tube end until there is only a  $\frac{1}{16}$ - to  $\frac{3}{32}$ -inch gap between the nut and the tube end.
- (4) Hold the sheave support against the end of the plunger so that the center line of the bore through the support will intersect the center line of the plunger at right angles.
- (5) Weld the support to the plunger with a  $\frac{1}{4}$ -inch weld all around.

*Note.* Do not allow weld to build up inside the support to an extent which will interfere with the sheave which is mounted in the support.

## Section IX. HYDRAULIC CYLINDERS

### 111. Description and Data

*a. DESCRIPTION.* Each of the two hydraulic cylinders is a double-acting hydraulic jack having an oilline port at each end of the cylinder. The two-piece piston (fig. 59) is bolted to the top end of the ram, and is fitted with eight piston packing rings. There is a removable rod end cover at the lower end of the cylinder. The lower ram end holds a bushing-type bearing for the pin which attaches the ram to the lift link.

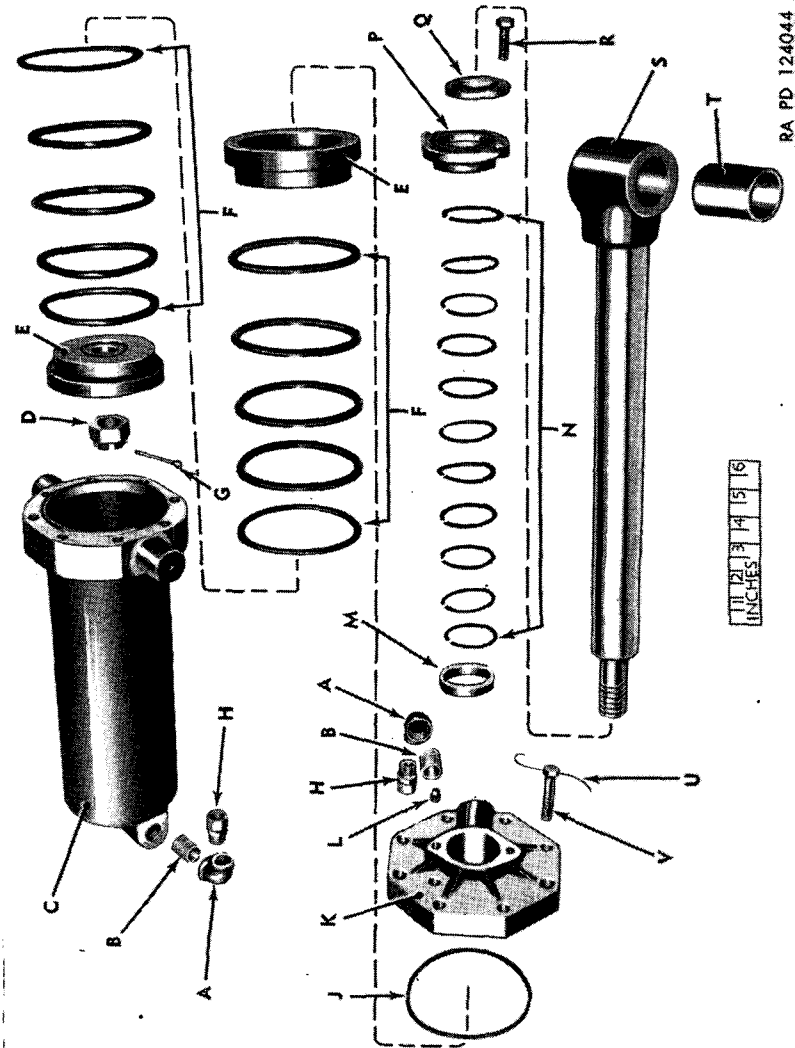


Figure 59. Hydraulic cylinder and ram—exploded view.

A—ELBOW, PIPE, REDUCING—90-DEG 1 X  $\frac{3}{4}$ —217986  
 B—NIPPLE, PIPE—1 X  $1\frac{1}{2}$ —127874  
 C—CYLINDER, HYDRAULIC—7323555  
 D—NUT— $1\frac{1}{2}$ —12NF-2—125104  
 E—PISTON—7323562  
 F—PACKING, PISTON—6 ID, 7 OD—7323559  
 G—PIN, COTTER— $\frac{1}{4}$  X 3—137318  
 H—UNION, TAPER THREAD— $\frac{3}{4}$  IN—7323313  
 J—RING, OIL SEAL—7323558  
 K—COVER, CYLINDER—7323563  
 L—PLUG, PIPE—1 IN—219303  
 M—RING, RAM—7323561  
 N—PACKING, RAM— $2\frac{1}{2}$  ID, 3 OD—7323560  
 P—GLAND, RAM PACKING—7323557  
 Q—SEAL, OIL, RAM—7323556  
 R—SCREW— $\frac{1}{2}$ —13NC-2 X  $1\frac{1}{2}$ —426959  
 S—RAM, PISTON—7323550  
 T—BEARING, BUSHING-TYPE—7323548  
 U—WIRE, LOCK—22-W-1642-125  
 V—BOLT— $\frac{5}{8}$ —18NF-2 X 3—223815

**b. DATA.**

Make----- Ordnance manufactured item  
 Type----- double-acting  
 Piston diameter----- 7 in.  
 Piston stroke----- 17 in.

## 112. Disassembly

**a. REMOVE RAM.**

- (1) Cut the lock wire and remove the eight bolts which secure the rod end cover to the welded hydraulic cylinder (fig. 59).
- (2) Slide the rod end cover out on the rod to the ram, away from the cylinder.
- (3) Remove the ram oil seal ring.
- (4) Pull the ram, with the piston attached and the rod end cover still on the rod, out of the welded hydraulic cylinder.

**b. REMOVE PISTON.**

- (1) Remove the split cotter pin (fig. 59) and castle nut from the end of the rod end of the ram.
- (2) Remove the two pieces of the piston, together with eight piston packing rings and two spacer rings, from the ram.
- (3) Drive the bushing-type bearing out of the ram eye, using a block of wood turned down to fit the eye.

**c. REMOVE RAM PACKING.**

- (1) Pull the ram out of the rod end cover (fig. 59).
- (2) Remove the two cap screws and remove the ram packing gland.

- (3) Tap the ram guide ring, together with the ram packing, out of the rod end cover.
- (4) Tap the piston ram seal out of the ram packing gland.

### **113. Cleaning, Inspection, and Repair**

*a. CLEANING.* Clean all metal parts thoroughly with volatile mineral spirits paint thinner, and dry them with filtered compressed air.

*b. INSPECTION AND REPAIR.* Carefully inspect the bearing surfaces of the two pistons, the interior of the welded hydraulic cylinder, the bore of the bushing-type bearing, and the surface of the ram rod for nicks and scratches. Polish out all rough spots, using a dry, medium abrasive cloth. Replace any parts which are badly damaged.

### **114. Assembly**

#### *a. INSTALL RAM IN ROD END COVER.*

- (1) Install the bushing-type bearing (fig. 59) in the ram eye.
- (2) Install the piston ram seal in the ram packing gland. Push it well up against the shoulder in the gland.
- (3) Place the ram packing gland over the rod end of the ram, pushing it well up onto the rod.
- (4) Place 11 new ram packing rings and the ram guide ring over the rod.
- (5) Insert the end of the rod through the bore in the rod end cover, and slowly push the rod through the cover, guiding the ring and packing into place inside the cover bore.
- (6) Finish pushing the packing into place by pushing the ram packing gland up against the outer surface of the rod end cover.
- (7) Secure the gland in place with two cap screws.

#### *b. INSTALL RAM AND ROD END COVER IN CYLINDER.*

- (1) Place one piece of the piston (fig. 59) over the ram rod end, with the large diameter end of the piston facing the ram eye.
- (2) Place four new piston packing rings and a spacer ring around the small diameter end of the piston piece.
- (3) Place four new packing rings and a spacer ring around the small diameter end of the other piston piece.
- (4) Install the second piston piece on the ram rod end, with the small diameter end facing the first piston piece.
- (5) Secure the two piston pieces to the ram rod with the castle nut, and insert a new split cotter pin to hold the nut.

- (6) Press a new ram oil seal ring into the groove around the open end of the welded hydraulic cylinder.
- (7) Guide the assembled piston into the welded hydraulic cylinder, pushing it well down into the cylinder.
- (8) Slide the rod end cover down against the end of the welded hydraulic cylinder, seating it properly against the ram oil seal ring.
- (9) Secure the cover in place with eight bolts and tie the bolt heads together with lock wire.



## CHAPTER 5

### SERVICEABILITY STANDARDS

---

#### 115. General

a. The serviceability standards included herein give the maximum and minimum dimensions of new or rebuilt parts. Wear limits are not given as these have not been adequately established for the equipment. It is suggested, however, that reasonable judgment be used in considering the actual clearance between any part and its mating part, before determining the serviceability or nonserviceability of any part. Parts which are uniformly worn to slightly less than minimum new dimensions can often be used successfully with mating parts which are slightly over minimum new dimensions.

b. When fitting mating parts, selection of parts must be resorted to in order to obtain desired clearances or interferences. The desired amount of clearance or interference between two parts is given here in terms of fits. If, for instance, a "push" fit is required, one or both parts must be hand picked to obtain the clearance allowable for this class of fit.

c. The four classes of fits referred to herein, and allowable clearance or interference for each, are as follows:

- (1) *Running fit.* The fit between two parts which must rotate or reciprocate without hinderence. Male part should be smaller than female part by 0.001 inch plus 0.001 inch for each inch of diameter.
- (2) *Push fit.* The fit between two parts which are not quite free to rotate or reciprocate; but which can be assembled together by hand. Male part should be 0.001 inch to 0.0001 inch smaller than female part.
- (3) *Driving fit.* The fit between two parts which must be assembled together by hammering or in a small arbor press. Male part should be same size as female part, or larger than female part by 0.001 inch for each inch of diameter.
- (4) *Forced fit.* The fit between two parts which must be assembled together in a hydraulic press. Male part should be larger than female part by 0.002 inch for each inch of diameter.

## 116. Hydraulic Pump Support

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
60	A	OD of two driven pulley shaft bearing outer races.	3.1491 to 3.1501 in.
60	B	ID of two driven pulley shaft bearing inner races.	1.5743 to 1.5753 in.

*Note.* Driven pulley shaft bearings are a push or driving fit (par. 115) on the driven pulley shaft, and are a push fit in the recesses of the hydraulic pump support.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
60	C	Width of driven pulley shaft spline----	0.24 to 0.251 in.
60	D	OD of two driven pulley shaft bearing journals and sleeve journal.	1.5747 to 1.5752 in.

*Note.* Run-out of driven pulley shaft at the spline is 0.002 inch.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
60	E	ID of driven pulley shaft sleeve-----	1.5732 to 1.5742 in.

*Note.* Sleeve is a driving fit (par. 115) on the driven pulley shaft.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
60	F	ID of bearing recesses inside hydraulic pump support.	3.1495 to 3.1505 in.

## 117. Hydraulic Pump

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	A	OD of both gears-----	3.390 to 3.391 in.
61	B	Pitch diameter of both gears-----	2.999 to 3.001 in.

*Note.* When assembled, center-to-center distance between drive and driven shafts must be 3.003 to 3.004 inch. There must not be any nicks or deep score marks on surfaces of gear teeth.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	C	Width of both gears-----	2.500 to 2.501 in.

*Note.* The two gears must be matched to be identical in width.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	D	ID of bores in both gears-----	1.4985 to 1.4990 in.

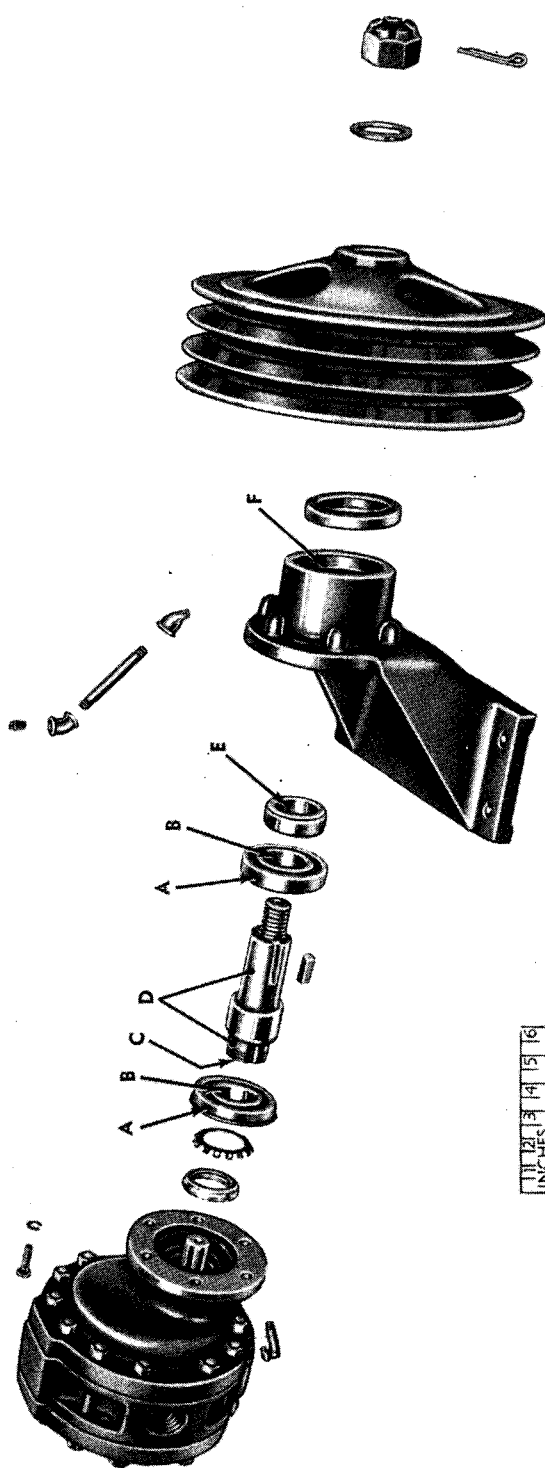
*Note.* Gears are push fits (par. 115) on the shafts.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	E	OD of driven shaft and of gear and bearing journal area of drive shaft.	1.4980 to 1.4985 in.
61	F	Free length of oilseal compression spring.	1.1875 in.
61	F	Spring length under 20-24 lb. load----	0.625 in.
61	G	Thickness of two wear plates-----	0.271 to 0.281 in.

*Note.* Faces of wear plates must be parallel to within 0.001 inch.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	H	ID of all four bearings-----	1.5005 to 1.5010 in.

*Note.* The two shafts are running fits (par. 115) in the bearings.



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Figure 60. Serviceability standards reference points—  
hydraulic pump support

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	J	OD of four check valve plungers-----	0.618 to 0.623 in.

*Note.* Plungers fit in their bores (S) with a clearance of 0.007 to 0.012 inch.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	K	ID of oil seal retainer-----	1.132 to 1.142 in.

*Note.* There is an allowable clearance of 0.008 to 0.017 inch between retainer (K) and shaft (P).

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	L	Thickness of oil seal retaining ring-----	0.0625 in.
61	M	Run-out of both shafts-----	0.001 in.
61	N	Width of drive shaft spline-----	0.241 to 0.244 in.
61	P	OD of oil seal retainer journal on drive shaft.	1.240 to 1.250 in.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	Q	ID of all four bearing recesses (two in each cover).	2.1870 to 2.1875 in.
61	R	OD of all four bearings-----	2.1875 to 2.1880 in.

*Note.* All four bearings are driving fits (par. 115) in the bearing recesses.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
61	S	ID of four check valve plunger bores (two in each cover).	0.625 to 0.635 in.

## 118. Hydraulic Pump Control Valve

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
62	A	OD of two ball bearings-----	2.6245 to 2.6250 in.
62	B	ID of two ball bearings-----	1.4995 to 1.5000 in.

*Note.* Bearings are driving fits (par. 115) on rotor journals and are push fits in their recesses.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
62	C	OD of two ball-bearing journals on rotor.	1.4999 to 1.5004 in.

*Note.* Inspect cam faces on each side of rotor. If there is any indication of grooving, replace rotor.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
62	D	ID of two ball-bearing recesses in valve body.	2.6247 to 2.6252 in.
62	E	OD of cam plunger roller-----	0.624 to 0.625 in.
62	F	ID of cam plunger roller-----	0.2515 to 0.2520 in.
62	G	Free length of cam roller plunger pin---	2.0625 in.
62	H	OD of cam plunger roller pin-----	0.2485 to 0.2490 in.

*Note.* There is an allowable clearance of 0.0025 to 0.0035 inch between pin (G) and roller (H).

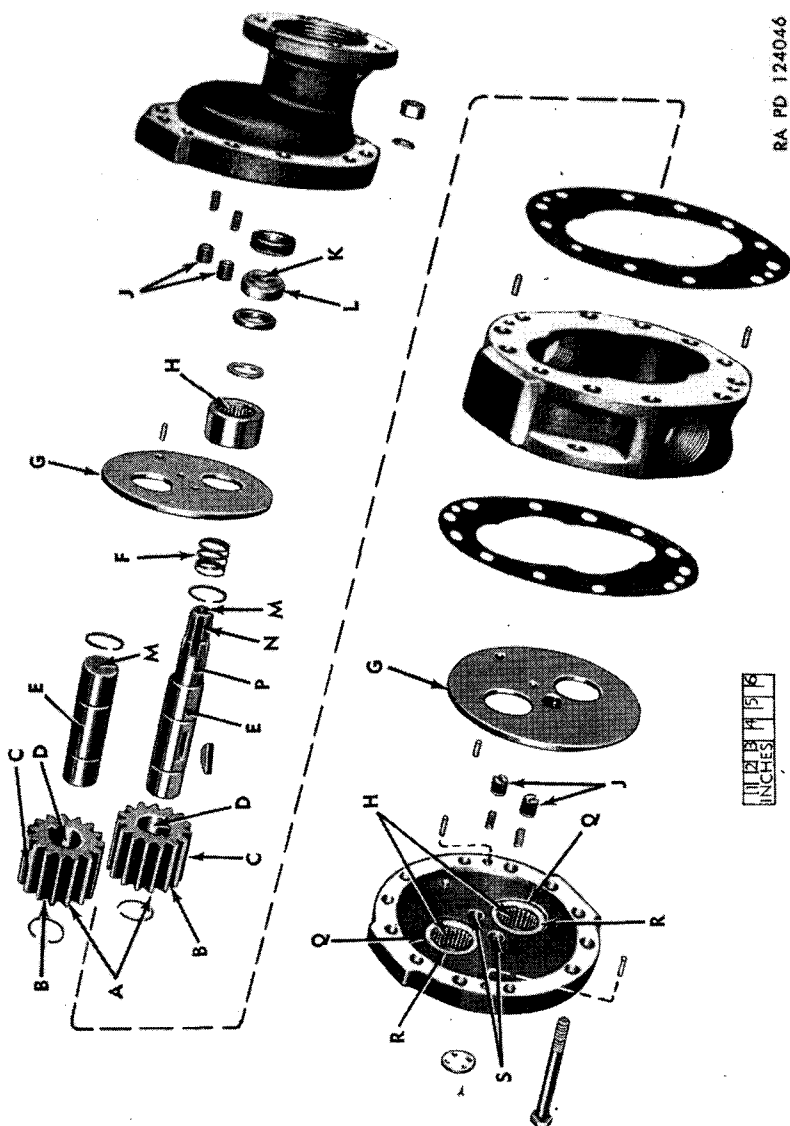


Figure 61. Serviceability standards reference points—hydraulic pump.

Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts
62	J	ID of cam plunger roller pin bores in cam roller plunger.	0.2490 to 0.2495 in.

Note. Cam roller plunger pin is a push fit (par. 115) in the plunger bores.

Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts
62	K	OD of relief valve shaft	0.373 to 0.375 in.
62	L	ID of relief valve shaft bore in valve body.	0.379 to 0.381 in.

*Note.* There is an allowable clearance of 0.004 to 0.008 inch between the shaft (K) and bore (L). If tapered (seating) surface of valve becomes grooved or scored, valve must be reground in seat (par. 101) or both valve and seat (in control valve head) must be replaced.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
62	M	Free length of relief valve spring-----	4.000 in.
62	N	ID of check valve pusher bore in valve body.	0.750 to 0.751 in.
62	P	ID of outer check valve bore in valve body.	1.125 to 1.127 in.
62	Q	OD of check valve pusher-----	0.747 to 0.749 in.

*Note.* There is an allowable clearance of 0.001 to 0.004 inch between the pusher (Q) and bore (N).

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
62	R	OD of outer check valve (larger diameter area).	1.121 to 1.123 in.

*Note.* There is an allowable clearance of 0.002 to 0.006 inch between the valve (R) and bore (P). If tapered (seating) surface of valve becomes grooved or scored, valve must be reground in seat (par. 101) or both valve and seat (in control valve body) must be replaced.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
62	S	ID of inner check valve bore in outer check valve.	0.312 to 0.313 in.
62	T	OD of inner check valve stem-----	0.309 to 0.311 in.

*Note.* There is an allowable clearance of 0.001 to 0.004 inch between the valve stem (T) and bore (S). If tapered (seating) surface of valve becomes grooved or scored, valve must be reground in seat or both the inner check valve and the outer check valve (in which inner check valve seat is located) must be replaced.

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
62	U	Free length of check valve spring-----	2.000 in.

## 119. Emergency-Lift Hand-Operated Pump

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
63	A	Four check valve balls must be round to within.	0.0001 in.
63	B	ID of plunger operating lever pin bore in plunger-operating lever.	0.4395 to 0.4405 in.
63	C	OD of plunger-operating lever boss----	0.4930 to 0.4970 in.

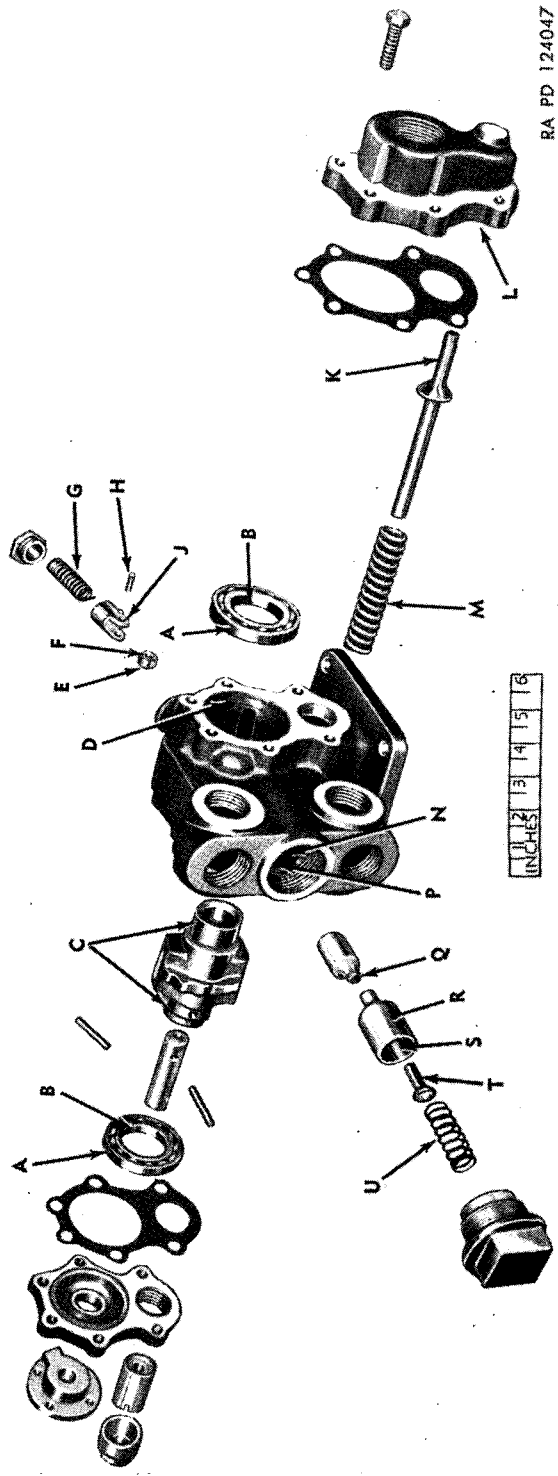
*Note.* There is an allowable clearance of 0.006 to 0.014 inch between the boss (C) and bore (F).

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
63	D	OD of plunger-operating lever pin-----	0.4370 to 0.4375 in.

*Note.* There is an allowable clearance of 0.002 to 0.0035 inch between the pin (D) and bore (B).

<i>Fig. No.</i>	<i>Ref. letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
63	E	ID of plunger bore in pump housing---	0.5630 to 0.5635 in.
63	F	ID of plunger-operating lever boss bore in plunger.	0.5030 to 0.5070 in.
63	G	OD of plunger-----	0.5615 to 0.5620 in.

*Note.* Plunger is a running fit (par. 115) in its bore.



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Figure 62. Serviceability standards reference points—hydraulic pump control valve.

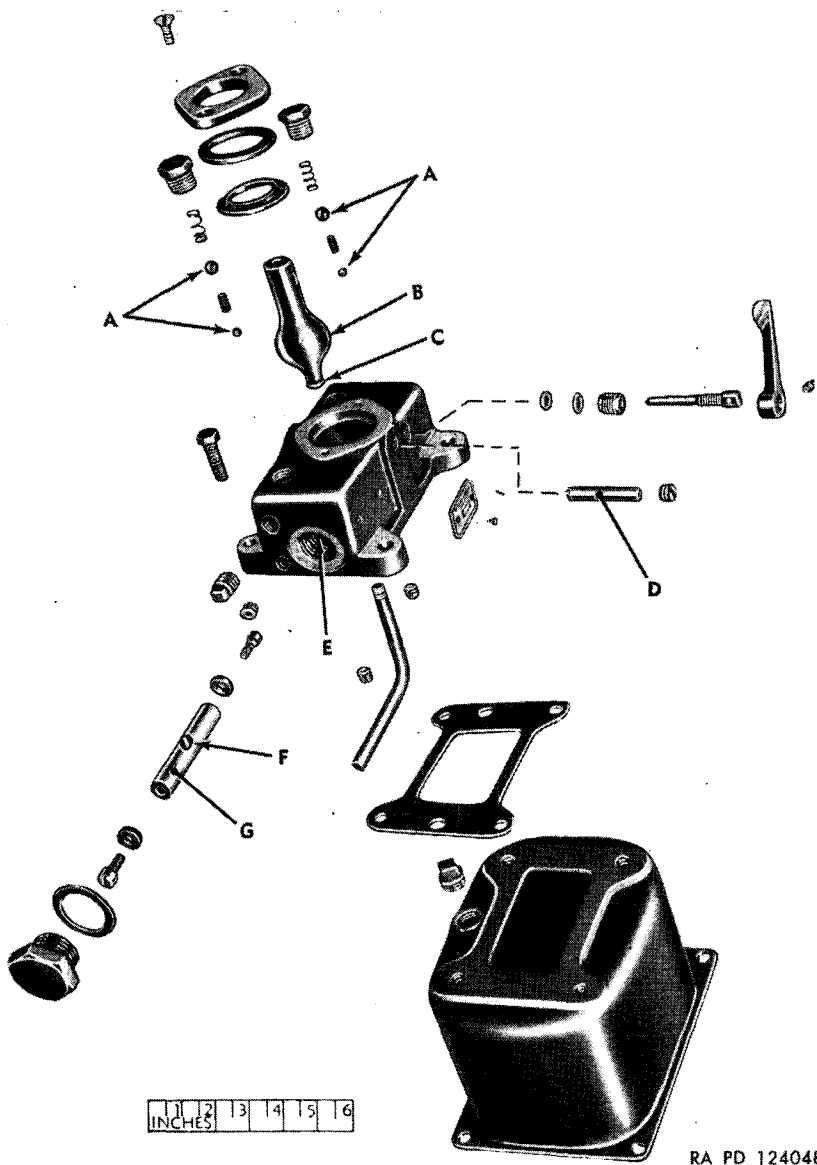


Figure 63. Serviceability standards reference points—emergency-lift hand-operated pump.



## CHAPTER 6

# SHIPMENT AND LIMITED STORAGE AND DESTRUCTION TO PREVENT ENEMY USE

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### Section I. SHIPMENT AND LIMITED STORAGE

#### 120. Domestic Shipping and Limited Storage Instructions

*a.* DOMESTIC SHIPPING INSTRUCTIONS.

- (1) *Preparation.* When shipping the tank-mounting bulldozer M2 (either mounted on the medium tank M4A3 or crated) interstate or within the zone of interior, the officer in charge of preparing the shipment *will be responsible* for furnishing matériel to the carriers for transport in a *serviceable* condition properly cleaned, preserved, painted, lubricated, etc., as prescribed in SB 9-4.

**Caution:** Personnel withdrawing matériel from a limited storage status for domestic shipment must not remove preservatives other than to insure that matériel is complete and serviceable. If preservatives have been removed, they must be restored prior to shipment. The removal of preservatives is the responsibility of depots, ports, or field installations (posts, camps, and stations) receiving the shipments.

- (2) *Preparation for shipment to ports.*

- (a) *Inspection standards.* All used vehicles equipped with tank-mounting bulldozers M2 destined for oversea use will be inspected prior to shipment to determine their serviceability in accordance with standards given in TB ORD 385.
- (b) *Processing for shipment to ports.* All vehicles equipped with tank-mounting bulldozers M2 destined to ports of embarkation for oversea shipment will be further processed in accordance with SB 9-4.

*Note.* Ports of embarkation will supplement any necessary or previously omitted processing upon receipt of vehicle.

- (3) *Army shipping documents.* Prepare all Army shipping documents accompanying freight in accordance with TM 38-705.

**b. LIMITED STORAGE INSTRUCTIONS.**

**(1) General.**

- (a) Matériel received already processed for domestic shipment as indicated on the vehicle processing record tag, WD AGO Form 9-3, need not be reprocessed unless the inspection performed on receipt of vehicles reveals corrosion, deterioration, etc.
- (b) Completely process matériel prior to storage if the processing data recorded on the tag indicates matériel has been rendered ineffective by operation, freight shipping damage, or upon their receipt directly from manufacturing facilities.
- (c) Matériel to be prepared for limited storage must be given a limited technical inspection and processed as prescribed in SB 9-63. The results and classification of the vehicle will be entered on DA AGO Form 461-5.

**(2) Receiving inspections.**

- (a) Report of matériel received in a damaged condition or improperly prepared for shipment will be reported on DD Form 6 in accordance with SR 745-45-5.
- (b) The tank-mounting bulldozer M2 is received from the manufacturer with the loose parts packed in suitable crates, and the moldboard assembly secured by steel straps to a heavy wooden skid (fig. 6). Unpack the units as prescribed in paragraph 7.

*Note.* The bulldozer is installed on the medium tank M4A3, and becomes an integral part of the tank after installation (par. 8).

- (c) Immediately upon receipt of tank-mounting bulldozers either mounted or boxed, they must be inspected and serviced as prescribed in section I, chapter 2. Perform a systematic inspection and replace or repair all missing or broken parts. If repairs are beyond the scope of the unit and the matériel will be out-of-service for an appreciable length of time, store them in a limited storage status and attach a tag to the matériel specifying the repairs needed. The report of these conditions will be submitted by the unit commander for action by an ordnance maintenance unit.
- (3) Inspections during storage.** Perform a visual inspection periodically to determine general condition. If corrosion is found on any part, remove the rust spots, clean, paint, and treat with the prescribed preservatives.

*Note.* Touch-up painting will be in accordance with TM 9-2851.

(4) *Removal from limited storage.*

- (a) If the bulldozers are not shipped or issued upon expiration of the limited storage period, they may either be processed for another limited storage period or be further treated for stand-by storage (matériel inactivated for periods in excess of 90 days up to 3 years) by ordnance maintenance personnel.
  - (b) If bulldozers to be shipped will reach their destination within the scope of the limited storage period, they need not be reprocessed upon removal from storage unless inspection reveals it to be necessary according to anticipated in-transit weather conditions.
  - (c) Deprocess bulldozers when it has been ascertained that they are to be placed into immediate service. Remove all rust-preventive compounds and thoroughly lubricate as prescribed in section II, chapter 3. Inspect and service bulldozers as prescribed in section I, chapter 2.
  - (d) Repair and/or replace all items tagged in accordance with (2) (c) above.
- (5) *Storage site.* The preferred type of storage for bulldozer is under cover in open sheds or warehouses whenever possible. Where it is found necessary to store bulldozers outdoors, they must be protected against the elements as prescribed in TB ORD 379.

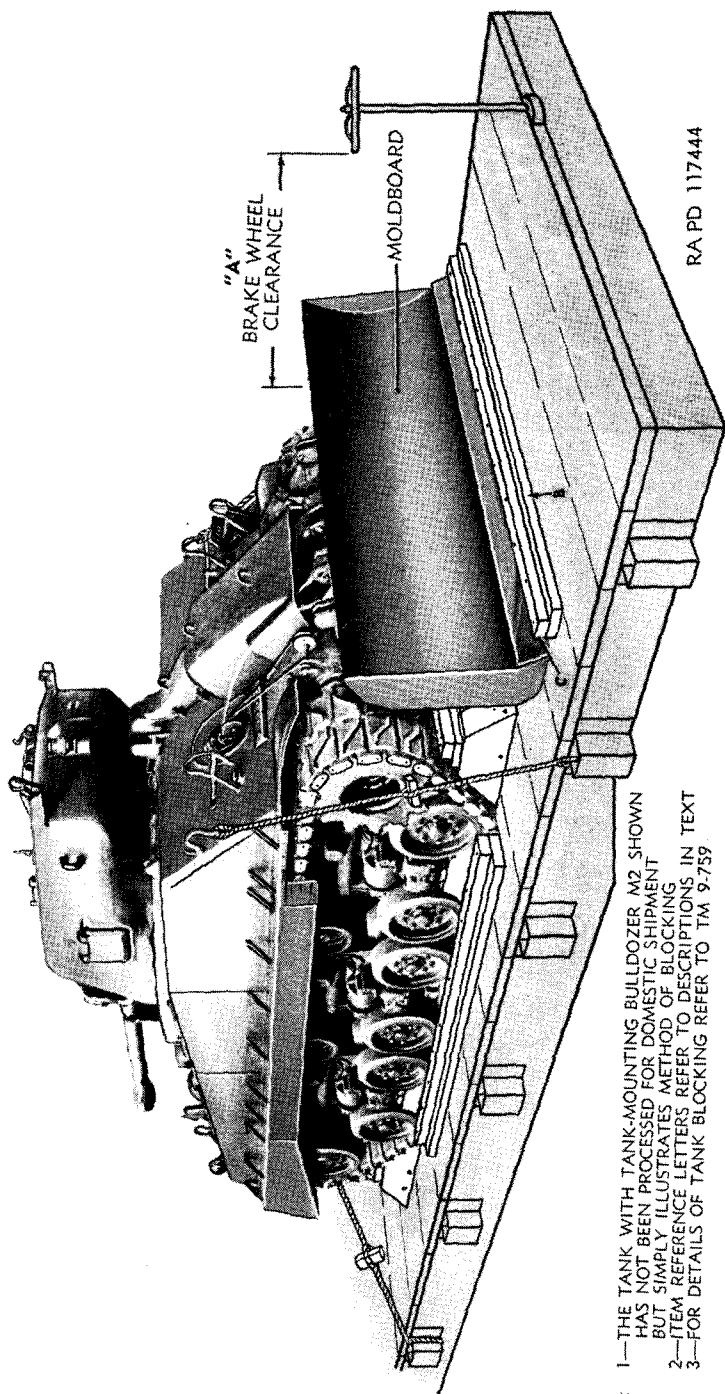
## **121. Loading and Blocking Medium Tank M4A3 With Tank-Mounting Bulldozer M2**

*a. SHIPPING INSTRUCTIONS.* Load and block the medium tank M4A3 on freight car as prescribed in TM 9-759.

*Note.* Prior to loading tank on freight car, the bulldozer moldboard must be placed in the raised position.

*b. BULLDOZER BLOCKING INSTRUCTIONS.*

- (1) After the tank has been loaded and blocked on flatcar lower the moldboard until it rests on the car floor.
- (2) Locate a 2 x 6-inch cleat "B," length to suit crosswise of car floor against front of moldboard. Nail to car floor with thirtypenny nails staggered along its length. Locate a 2 x 4-inch cleat "C," length to suit on top of cleat "B." Nail to cleat "B" and car floor with forty penny nails staggered along its length (fig. 64).



RA PD 117444

- NOTES:
- 1—THE TANK WITH TANK-MOUNTING BULLDOZER M2 SHOWN HAS NOT BEEN PROCESSED FOR DOMESTIC SHIPMENT BUT SIMPLY ILLUSTRATES METHOD OF BLOCKING
  - 2—ITEM REFERENCE LETTERS REFER TO DESCRIPTIONS IN TEXT
  - 3—FOR DETAILS OF TANK BLOCKING REFER TO TM 9-759

Figure 64. Method of blocking medium tank M4A3 with bulldozer M2 for rail shipment.

## Section II. DESTRUCTION OF MATÉRIEL TO PREVENT ENEMY USE

### 122. General

*a.* Destruction of the bulldozer, when subject to capture or abandonment in the combat zone, will be undertaken by the using arm only when, in the judgment of the unit commander, such action is necessary in accordance with orders of, or policy established by, the army commander.

*b.* The information which follows is for guidance only. Certain of the procedures outlined require the use of explosives and incendiary grenades which normally may not be authorized items for the vehicle. The issue of these and related materials, and the conditions under which destruction will be effected, are command decisions in each case, according to the tactical situation. Of the several means of destruction, those most generally applicable are:

Mechanical—Requires axe, pick mattock, sledge, crowbar, or similar implement.

Burning—Requires gasoline, oil, incendiary grenades, or other inflammables.

Demolition—Requires suitable explosives or ammunition.

Gunfire—Includes artillery, machine guns, rifles using rifle grenades, and launchers using antitank rockets. Under some circumstances hand grenades may be used.

In general, destruction of essential parts, followed by burning will usually be sufficient to render the matériel useless. However, selection of the particular method of destruction requires imagination and resourcefulness in the utilization of the facilities at hand under the existing conditions. Time is usually critical.

*c.* If destruction to prevent enemy use is resorted to, the matériel must be so badly damaged that it cannot be restored to a usable condition in the combat zone, either by repair or cannibalization. Adequate destruction requires that all parts essential to the operation of the matériel, including essential spare parts, be destroyed or damaged beyond repair. However, when lack of time and personnel prevents destruction of all parts, priority is given to the destruction of those parts most difficult to replace. Equally important, the same essential parts must be destroyed on all like matériel so that the enemy cannot construct one complete unit from several damaged ones.

*d.* If destruction is directed, due consideration should be given to—

- (1) Selection of a point of destruction that will cause greatest obstruction to enemy movement and also prevent hazard to

friendly troops from fragments or ricocheting projectiles which may occur incidental to the destruction.

- (2) Observance of appropriate safety precautions.

### 123. Destruction of the Tank-Mounting Bulldozer M2

*Note.* The following instructions contain a method of destruction to be used only when the bulldozer is separate from the tank. If the bulldozer has been assembled to the tank and both are to be destroyed, the charges described below for destruction of the bulldozer should be connected for simultaneous detonation with the charges set for destruction of the tank (TM 9-759). Method—with demolition materials.

a. Prepare five 2-pound charges of **EXPLOSIVE**, TNT (two 1-pound blocks or equivalent per charge). Set the charges as follows:

- (1) *One* charge on the left tilt-arm bracket, and *one* charge on the right tilt-arm bracket.
- (2) *One* charge on the left push-beam bracket and *one* charge on the right push-beam bracket.
- (3) *One* charge between the two hydraulic cylinders.

b. Connect the five charges for simultaneous detonation with detonating cord. Provide for dual priming to minimize the possibility of misfire. For priming, either a nonelectric blasting cap crimped to at least 5 feet of safety fuse (safety fuse burns at the rate of 1 foot in 30 to 45 seconds—test before using) or an electric blasting cap and firing wire may be used. Safety fuse, which contains black powder, and blasting caps must be protected from moisture at all times. The safety fuse may be ignited by a fuse lighter or a match; the electric blasting cap requires a blasting machine or equivalent source of electricity.

**Caution:** Keep the blasting caps, detonating cord, and safety fuse separated from the charges until required for use.

*Note.* For the successful execution of methods of destruction involving the use of demolition materials, all personnel concerned will be thoroughly familiar with the provisions of FM 5-25. Training and careful planning are essential.

c. Detonate the charges. If primed with nonelectric blasting cap and safety fuse, ignite and take cover. If primed with electric blasting cap, take cover before firing. Elapsed time: about 5 minutes.

## APPENDIX

### REFERENCES

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#### 1. Publications Indexes

The following publications indexes and lists of current issue should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to matériel covered in this manual:

- a.* Index of Administrative Publications.....SR 310-20-5
- b.* Index of Army Motion Pictures and Film Strips....SR 110-1-1
- c.* Index of Army Training Publications.....SR 310-20-3
- d.* Index of Blank Forms and Army Personnel Classification Tests.....SR 310-20-6
- e.* Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, Tables of Equipment, and Tables of Basic Allowances  
SR 310-20-4
- g.* Military Training Aids.....FM 21-8

#### 2. Supply Catalogs

The following catalogs of the Department of the Army Supply Catalog pertain to this matériel:

*a.* AMMUNITION.

Land Mines and Fuzes, Demolition Matériel, and Ammunition for Simulated Artillery and Grenade Fire...ORD 11 SNL R-7

*b.* MAINTENANCE AND REPAIR.

Antifriction Bearings and Related Items.....ORD 5 SNL H-12  
Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials.....ORD 3 SNL K-1  
Items of Soldering, Metallizing, Brazing and Welding Materials: Gases and Related Items.....ORD 3 SNL K-2

Lubricating Equipment, Accessories and Related Dispensers.

ORD (\*) SNL K-3

Major Items and Major Combinations of Group G.

ORD 3 SNL G-1

Miscellaneous Hardware-----ORD 5 SNL H-2

Oil Seals-----ORD 5 SNL H-13

Ordnance Maintenance Sets-----ORD 6 SNL N-21

Pipe and Hose Fittings-----ORD 5 SNL H-6

Standard Hardware-----ORD 5 SNL H-1

Tool-sets (special), Motor Vehicles-----ORD 6 SNL G-27, Sec 1

Tool-sets (common), Specialists' and Organizational.

ORD 6 SNL G-27, Sec 2

*c.* **BULLDOZER AND VEHICLE.**

Bulldozer, Tank-Mounting, M2-----ORD (\*) SNL G-247

Tank, Medium, M4A3, 76-mm Gun-----ORD (\*) SNL G-205

### **3. Explanatory Publications**

The following explanatory publications contain information pertinent to this matériel and associated equipment.

*a.* **AMMUNITION.**

Allocation and Distribution of Training Ammunition and Explosives Within the Zone of Interior-----SR 710-60-50

Ammunition, General-----TM 9-1900

Ammunition: General-----SB 9-AMM-1

Explosives and Demolitions-----FM 5-25

Qualification in Arms and Ammunition Training Allowances-----AR 775-10

Range Regulations for Firing Ammunition for Training, Target Practice, and Combat-----SR 385-310-1

*b.* **CAMOUFLAGE.**

Camouflage-----TM 5-267

Camouflage, Basic Principles-----FM 5-20

Camouflage of Vehicles-----FM 5-20B

*c.* **DECONTAMINATION.**

Decontamination-----TM 3-220

Decontamination of Armored Force Vehicles-----FM 17-59

Defense Against Chemical Attack-----FM 21-40

Miscellaneous Gas Protective Equipment-----TM 3-290

*d.* **GENERAL.**

Dictionary of United States Army Terms-----SR 320-5-1

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\*See ORD 1, Introduction and Index, for published catalogs of the ordnance section of the Department of the Army Supply Catalog.



*d.* GENERAL—Continued

Driver Selection, Training and Supervision, Half-Track and Full-Track Vehicles.....	TM 21-301
Driver's Manual.....	TM 21-305
First Aid for Soldiers.....	FM 21-11
General Safety Manual.....	TM 20-350
Inspection of Ordnance Matériel.....	TM 9-1100
Manual for the Full-Track Vehicle Driver.....	TM 21-306
Military Vehicles.....	TM 9-2800
Mountain Operations.....	FM 70-10
Operations in Snow and Extreme Cold.....	FM 70-15
Precautions in Handling Gasoline.....	AR 850-20
Principles of Automotive Vehicles.....	TM 9-2700

*e.* MAINTENANCE AND REPAIR.

Basic Maintenance Manual.....	TM 38-650
Cleaning, Preserving, Sealing, and Related Materials Issued for Ordnance Matériel.....	TM 9-850
Hand, Measuring, and Power Tools.....	TM 10-590
Instruction Guide: Care and Maintenance of Ball and Roller Bearings.....	TM 37-265
Lubrication.....	TM 9-2835
Maintenance and Care of Hand Tools.....	TM 9-867
Modification of Ordnance Matériel.....	SB 9-38
Motor Vehicle Inspection and Preventive Maintenance Services.....	TM 37-2810
Painting Instructions for Field Use.....	TM 9-2851
Preparation of Ordnance Matériel for Deep Water Fording.....	TM 9-2853
Reclamation of Parts From General Purpose Type Vehicles.....	SB 9-62

*f.* SHIPMENT.

Army Marking Directive.....	TM 38-414
Army Shipping Document.....	TM 38-705
Instruction Guide: Ordnance Packaging and Shipping (Posts, Camps, and Stations).....	TM 9-2854
Ordnance Storage and Shipment Chart—Group G	TB 9-OSSC-G
Preparation of Unboxed Ordnance Matériel for Shipment.....	SB 9-4
Protection of Ordnance General Supply in Open Storage	TB ORD 379
Rules Governing the Loading of Mechanized and Motorized Army Equipment, Also Major Caliber Guns, for the United States Army and Navy, on Open Top Equipment Published	

by Operations and Maintenance Department of Associations  
of American Railroads

Shipment of Supplies and Equipment----- SR 745-45-5

Standards for Oversea Shipment and Domestic Issue of

Ordnance Matériel Other Than Ammunition and Army

Aircraft----- TB ORD 385

Storage, Inspection, and Issue of Unboxed Serviceable Motor

Vehicles; Preparation of Unserviceable Vehicles for Storage;

and Deprocessing of Matériel Prior to Operation----- SB 9-63

Supplies and Equipment—Motor Vehicles----- AR 700-105

*g.* VEHICLES.

Medium Tank M4A3----- TM 9-759

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